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Soviet Geography: Review and Translation

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TRANSLITERATION TABLE

Russian			English	Russian			English
А	а	*а*	a	Р	р	*р*	r
Б	б	*б*	b	С	с	*с*	s
В	в	*в*	v	Т	т	*т*	t
Г	г	*г*	g	У	у	*у*	u
Д	д	*д*	d	Ф	ф	*ф*	f
Е	е	*е*	e*	Х	х	*х*	kh
Ж	ж	*ж*	zh	Ц	ц	*ц*	ts
З	з	*з*	z	Ч	ч	*ч*	ch
И	и	*и*	i	Ш	ш	*ш*	sh
Й	й	*й*	y	Щ	щ	*щ*	shch
К	к	*к*	k	Ъ	ъ	*ъ*	"
Л	л	*л*	l	Ы	ы	*ы*	y
М	м	*м*	m	Ь	ь	*ь*	'
Н	н	*н*	n	Э	э	*э*	e
О	о	*о*	o	Ю	ю	*ю*	yu
П	п	*п*	p	Я	я	*я*	ya

(*) Instead of e, use ye at the beginning of names, after vowels and after the soft sign (').

The transliteration table is supplied for the general information of readers and to enable them to identify the geographic names on maps that will be reproduced from time to time in SOVIET GEOGRAPHY.

The transliteration system is the one proposed by the United States Board on Geographic Names. For more general use in textbooks and other popular needs, the following simplifications are recommended by the editor of SOVIET GEOGRAPHY:

1. Eliminate the use of (') and (").
2. Use i for iy, and y for yy.
3. Convert diphthongs ay, ey, oy, uy to ai, ei, oi, ui.

THE THIRD CONGRESS OF THE GEOGRAPHICAL SOCIETY OF THE USSR

THE HEAT BALANCE OF THE EARTH'S SURFACE

By M. I. Budyko

(Abstract: The article discusses the present state of knowledge of the basic components of the heat balance of the earth's surface (radiation balance, loss of heat to evaporation, turbulent heat exchange) and the distribution of these components in time and space. Soviet research is concerned with applying heat-balance data to the study of physical-geographical processes (hydrologic regime, plant and soil cover), to the study of integrated geographic problems (geographic zonality) and practical problems (weather and hydrologic forecasting, the use of solar energy for productive purposes, and the use of heat-balance data for planning reclamation projects and other nature-transforming measures.)

The law of the conservation and conversion of energy was discovered in the 1840's as a result of the research of Mayer, Joule and Helmholtz. This discovery exerted immense influence on the development of the natural sciences. The use of the law of the conservation of energy made it possible completely to reconstruct mechanics, thermodynamics, electrodynamics and other physical disciplines. Beginning with the second half of the 19th century, the law of the conservation of energy acquired great significance for the study of biological questions, including the physiology of plants and animals.

In the geographic sciences, the treatment of the problem of the energy balance was started in the framework of the hydrometeorological disciplines.

In the 1880's A. I. Voyeykov clearly formulated the proposition that the basic energy transformations in the external geographic envelope are related to the transformation of the energy of the sun.

At the end of the 19th century systematic observations began to be made of the receipt of solar energy on the earth's surface. The development of these measurements in the 20th century gave rise to a world-wide network of actinometric stations. Starting about 1910, Schmidt, Angström and other authors posed the question of how the solar energy absorbed by the earth's surface is transformed and what quantitative indices characterize these transformations. This was the beginning of research in the heat balance of the earth's surface.

This research has brought out the fact that the transformations of solar energy on the earth's surface have the following basic forms:

Part of the solar energy absorbed by the earth's surface passes into the

atmosphere and outer space in connection with the loss of heat on long-wave radiation. The difference between the amount of absorbed solar radiation and the loss of energy on effective long-wave radiation is commonly called the radiation balance of the earth's surface. The mean annual magnitudes of the radiation balance for most of the earth's surface are positive. Only in regions with a permanent snow cover do these magnitudes approach zero or reach negative values of small absolute magnitude. In the oceans and in land areas with a more or less humid climate the larger part of the energy of the radiation balance is lost to evaporation. Thus evaporation from the land surface, a major factor in the water balance, at the same time exerts an enormous influence upon the heat balance.

The remainder of the radiation balance is lost in the heat exchange between the earth's surface and the atmosphere and in the heating of the upper layers of the hydrosphere or lithosphere. On the seas and oceans the heat exchange between the surface and underlying layers of the water can reach very high values because of the action of sea currents, which carry the heat from warmer to colder sections of the seas.

The other components of the energy balance of the earth's surface are usually much smaller in magnitude than the above-mentioned components of the heat balance. However, some of the lesser components have great significance in the general complex of external geographic processes, as for example the loss of heat to photosynthesis giving rise to relatively stable forms of chemical energy.

We will now discuss the present state of the study of the basic components of the heat balance of the earth's surface.

Radiation balance. Actinometric measurements are now made at approximately 700 stations in different regions of the globe. Most of these stations measure only short-wave solar radiation, though in recent years a number of stations, located mainly in the USSR, have begun to measure also the radiation balance of the earth's surface.

It should be stressed that although available observation data on radiation flows have great significance for the solution of many theoretical and practical problems, they are inadequate for a detailed investigation of the radiation balance of the earth's surface in different geographic areas. Methods of calculating the flows of short-wave and long-wave radiation are therefore assuming importance in the study of the radiation balance.

Such methods have been worked out in a number of meteorological investigations. The improvement and wide application of calculation methods in the work performed at the Main Geophysical Observatory at Pulkovo have made it possible to construct world maps of the mean values of the radiation balance for each month and year. More detailed maps have been constructed for the territory of the USSR.

In addition to these investigations, information on the radiation balance for various areas and places on land and sea has been obtained in a large number of studies based on the application of calculative methods and the generalization of observation data.

The laws of distribution of the mean values of the radiation balance in space and in time are therefore now fairly well known. It may be supposed that after analysis of the observations made under the program of the International Geophysical Year, it will soon be possible to refine considerably our present knowledge of the radiation balance.

Loss of heat to evaporation. Since the latent heat of vaporization is a more or less constant magnitude, the determination of the loss of heat to evaporation reduces itself to a determination of evaporation.

The existing methods of measuring evaporation from the surface of land and inland water bodies are used at a number of hydrometeorological stations and have yielded a certain amount of data on systematic observations of evaporation.

It should be noted, however, that direct observation data relate to a limited number of regions and, as a rule, only approximately characterize the magnitude of evaporation in the respective areas. Hence mainly calculative methods are used to study the distribution of evaporation in space and time.

The method of calculating evaporation from water surfaces is somewhat simpler so that there is now a fairly large amount of data on the distribution of evaporation from the surface of the oceans, seas and inland water bodies.

Evaporation from land surfaces can be calculated relatively easily only for mean annual conditions, when the magnitude of evaporation can be found either by the water-balance equation (precipitation minus runoff), or with the aid of various hydroclimatic relationships. It is much more difficult to compute the evaporation from the land surface for shorter periods of time, particularly the mean evaporation for individual months. The question of the method of such calculations is now attracting the attention of many specialists.

It may be assumed that direct observation of changes in the moisture content of the upper layers of the soil is a major element in the determination of the annual march of evaporation. It is therefore important to ascertain as exactly as possible the dependence of evaporation from the land upon the retention of moisture by the soil.

As a result of research done at the Main Geophysical Observatory, it has recently been possible to construct a world map of the mean annual magnitudes of evaporation. Maps were also compiled showing the mean evaporation and the loss of heat to evaporation for various areas both for the year as a whole and for individual months. It should, however, be noted

that no maps of evaporation for individual months exist as yet for the world as a whole.

Turbulent heat exchange between the earth's surface and the atmosphere. Of the basic components of the heat balance, turbulent heat exchange is most difficult to determine directly from meteorological data. In the last few years observations of the turbulent heat exchange based on measurements of the vertical temperature gradient in the surface layer of the air have been started at a number of Soviet stations. These observations, fairly complex in method, have not yet yielded data in any large amounts. At present, the mean values of turbulent exchange on land are usually determined as a residual member in the heat-balance equation. It is much simpler to compute the turbulent heat exchange on water bodies, where its value can be determined by formulas similar to those for computing evaporation.

For turbulent heat exchange, just as for the loss of heat to evaporation, there are maps showing the distribution of mean annual values on land. Maps of the mean monthly magnitudes of turbulent heat exchange now exist only for the surface of the oceans. We have not yet succeeded in solving this problem for land conditions. A schematic world map of the mean annual values of turbulent heat exchange has been published together with a whole series of heat-balance maps prepared at the Main Geophysical Observatory.

Without dwelling upon the available materials regarding other components of the heat balance, we shall make some remarks regarding the reliability of the above-mentioned data on the components of the heat balance.

In discussing this question, it should be noted first that until relatively recently virtually nothing was known about the geographic distribution of the components of the heat balance.

Even at the end of the 1940's, the question of what sign should be prefixed to the annual values of the radiation balance of the land surface in the temperate latitudes was still being discussed in the literature. The situation was even less clear with regard to the sign of the mean values of turbulent heat exchange between the earth's surface and the atmosphere.

As a result of research in the climatology of the heat balance, done mainly in the last 10 to 15 years, much information has been obtained on the space-and-time distribution of the components of the heat balance that may be regarded as entirely trustworthy. This information gives an idea of the order of magnitudes of the heat-balance components in various geographic areas and the general laws of distribution of these components.

The accuracy of the available quantitative data on the components of the heat balance apparently varies considerably for different regions and for different components. It may be assumed that, with reliable data on the basic meteorological elements and with the application of the best existing calculating methods of determining the components of the balance, it is

possible to compute the basic components with an accuracy entirely sufficient for practical purposes. Very recently the possibilities of accurate determination of the components of the heat balance have increased considerably because of the accumulation of data from the special observations made in accordance with the program of the International Geophysical Year.

The accumulation of data on the heat balance of the earth's surface has contributed to the development of research linking the laws of the energy balance on the earth's surface to the dynamics of the natural surface processes.

This research has related to the study of the hydrologic regime, the plant and soil cover, as well as to the treatment of the problem of geographic zonality. We shall dwell in somewhat greater detail on the content of this research.

The hydrologic regime of the land. The main index of the hydrologic regime of the land is the runoff norm, i.e., the average annual amount of water running off from a unit area of the area under study. In 1911 E. M. Oldekop established that the runoff norm is determined mainly by climatic factors.

At the end of the 1940's researchers found the quantitative relationship between the runoff (or runoff coefficient), on the one hand, and the ratio of the radiation balance to precipitation, on the other.

In subsequent work in this direction, it proved possible to ascertain the laws relating changes in the yearly course of the components of the water balance of the upper soil layer to the heat balance. These laws are based on the unity of the processes of evaporation and loss of heat to evaporation, which are usually key factors in the equations of the water and heat balances.

Along with work in this direction, research performed at the Central Forecasting Institute, the State Hydrologic Institute and by other groups used the heat-balance method for calculations of the spring snow thaw leading to the formation of flood waters. In this case the heat-energy balance on the earth's surface directly governs the dynamics of the snow thaw, which makes it possible to use information on the heat balance in forecasting the time of disappearance of the snow cover and predicting the spring regime of rivers.

Data on the energy balance are also widely used in studying the hydrologic regime of inland water bodies. The energy balance on the surface of such water bodies governs the rate of evaporation, the conditions of the thermal regime and the dynamics of ice formation and ice thaw. Accordingly, heat-balance data are used in calculating the water balance of water bodies, and in calculating and forecasting ice phenomena.

The plant cover. As is known, the existence of a plant cover is directly connected with the balance of solar energy on the earth's surface, inasmuch as the process of photosynthesis is based entirely on the absorption of a certain part of the radiation received from the sun. While only a comparatively

small part of the energy of the radiation balance is usually lost to photosynthesis, the loss of energy to plant transpiration in many cases proves to be one of the main components of the heat balance. The latter circumstance apparently has substantial significance for the explanation of many laws of the development of the plant cover.

In addition to its direct effect on the processes of photosynthesis and transpiration, the heat-energy balance exercises substantial indirect influence upon the conditions of development of vegetation since the temperature of the plant cover and the soil moisture depend essentially upon the relationship between the components of the heat balance.

In the work done at the Main Geophysical Observatory, a study was made of certain questions entering into the general problem of the effect of the thermal energy balance on the development of vegetation. This work resulted in establishing the physical interdependence between the transpiration coefficients of plants and the coefficients characterizing the assimilation of solar energy in the photosynthesis process. Accordingly, it was found possible to analyze the qualitative laws relating the productivity of the natural plant cover to climatic factors.

Deserving of mention in this connection is the research of S. A. Sapozhnikova examining the question of the relationship between the northern boundary of distribution of certain crops and the energy balance of the transpiration process.

It appears to us that research on the direct effect of energy factors on the development of plants, done so far in various geographic areas, is only a first step in the treatment of this complex but extremely important problem.

The effect of energy factors on the thermal regime of the development of plants near the surface of the ground is somewhat easier to determine.

The calculation of the components of the heat balance of the plant cover makes it possible to determine the temperature of the surface of plants, which is often found to differ considerably from the air temperature. Similar methods can be applied in determining the surface temperature of the bodies of animals, both cold-blooded (having no thermal regulation) and warm-blooded (possessing thermal regulation).

Such calculations can have significance for the solution of various problems of the bioclimatology of plants and man.

The soil cover. The question of the energy factors of the soil-formation process has been inadequately studied thus far. From the general viewpoint, it is evident that the heat balance of the earth's surface exercises an influence on soil processes in several ways.

First, the thermal regime of the soil depends essentially upon the

relationship between the components of the heat balance and particularly upon the heat circulation in the soil.

Second, the heat balance, as we have noted above, exercises a profound effect upon the water balance of the soil, including the soil-moisture regime and the percolation of water through the upper soil horizons.

Third, the conditions of the heat balance dictate to a certain extent the productivity of the plant cover, which in turn governs the conditions under which organic matter produced in the photosynthesis process enters into the soil.

Although the whole complex of these relationships has still not been examined in the current research, certain particular questions of the effect of energy factors on the soil processes have been studied.

In particular, the question of calculating the thermal regime of soils on the basis of data on the thermal energy balance has been examined in many theoretical studies, especially in conjunction with the study of the dynamics of the freezing and thawing of soils.

Without touching here upon the question of the use of heat-balance data in studying soil zonality (which we will discuss below), let us note that in our opinion the application of the method of integrated analysis of energy transformations in the soil embodies great prospects for the explanation of the general laws of soil formation.

In this brief review, we are unable to dwell on current research concerning the use of data on the heat-energy balance in studying other natural processes.

We shall now take up the question of applying the concepts of the energy balance to the study of integrated geographic problems.

Geographic zonality. The concept of geographic zonality formulated by V. V. Dokuchayev is a basic empirical generalization of modern physical geography. The doctrine of zonality may be regarded as the main link among the particular geographic disciplines that make up physical geography in the broad sense of the word.

This explains the special significance of research on the general laws of geographic zonality.

V. V. Dokuchayev and G. S. Vysotskiy were among the first to draw attention to the relationship between the distribution of geographic zones and the indices of climatic moisture supply.

A substantial advance in the study of geographic zonality was made by A. A. Grigor'yev, who pointed out the significance of the ratio of the radiation balance to precipitation for zonal changes in various natural processes. His work first established the connection between geographic zonality and the conditions of the energy balance.

Later, A. A. Grigor'yev and other authors concentrated on the question of the energy factors of geographic zonality. By applying the method of comparative geographic analysis and taking account of a number of geophysical laws, they succeeded in working out a scheme of the periodic law of geographic zonality, establishing the connection between geographic zones and the indices of the heat and water balances. It has proved possible to use this scheme to explain various laws of zonality of individual natural processes, and also to apply it to a system of physical-geographic classification of climate.

It should be noted that the question of the connections between geographic zonality and energy factors has also been studied by D. L. Armand, V. R. Volobuyev and others. Without dwelling in more detail on this question, we shall proceed to examine the possibilities of the practical use of the data on the heat-energy balance of the earth's surface.

Practical problems. Let us examine the three main fields of practical use of data on the heat-energy balance of the earth's surface. The first involves the employment of data in working out various methods of hydrometeorological forecasting.

Inasmuch as the heat balance of the earth's surface governs the basic forms of transformation of solar energy in the external geographic envelope, it is evident that the data on the components of the balance are of prime significance for a causal explanation of the laws of the hydrometeorological regime of the atmosphere and hydrosphere.

In the last few years, as a result of theoretical research of the genesis of climate, L. R. Rakipova and other authors have established relationships between the distribution of the components of the heat balance and the fields of the basic meteorological elements. This research has confirmed the idea that the components of the balance are one of the essential factors of the genesis of climate.

The heat balance of the earth's surface also exerts a considerable effect on weather conditions. This makes it possible to use data on the heat balance in weather forecasting research.

To be mentioned in this connection, by way of example, is the work of M. Ye. Berlyand and M. V. Zavarina. Using data on the heat balance of the earth's surface they have worked out new methods of calculating transformations of air masses and methods of local forecasting of changes of temperature and humidity in the surface layer of the air. Such methods are particularly important for predicting frosts and fogs.

N. A. Belinskiy and other authors have used data on the heat balance of the oceans to calculate weather changes over longer periods of time. Further research along that line may make it possible to improve existing methods of long-range weather forecasting.

Along with the work in weather forecasting, data on the heat balance are also widely used in hydrologic forecasting. We have already mentioned the schemes for forecasting the freezing of water bodies, the thawing of ice on water and of snow on land, based on calculations of the heat balance.

A second field of practical application of information on the heat balance relates to the direct use of solar energy in production processes.

In the last few years, technical improvements have increased the possibilities for the employment of installations transforming the radiant energy of the sun into other forms of energy more suitable for practical utilization. To calculate the efficiency of such installations, we need detailed data on the radiation regime and the radiation balance of those regions where these installations operate.

Similar data are required to calculate such production processes as the natural drying of peat and other materials by means of the radiant energy of the sun.

The most important of the production processes directly utilizing solar energy is that of crop growing.

In order to study the relations between the conditions of crop development and the radiation regime, a number of studies have been carried out, in which the indices of plant development were compared with the characteristics of the radiation conditions, particularly with those of the physiologically active radiation of the sun.

Data on the radiation balance have also been used in studying the conditions of plant development on slopes of different steepness and orientation. As a result of this research, it has been possible to explain in physical terms the difference, already well known from practical experience, between the conditions of plant growth on northern and southern exposures.

The third field of practical use of data on the radiation and heat balances involves the justification of various measures for transforming natural conditions and the calculation of the effectiveness of such measures.

One of the main methods of reclamation in regions of insufficient moisture is the employment of artificial irrigation. The correct calculation of water requirements is of great significance.

Since the process of evaporation from irrigated fields depends to a large degree on the conditions of the energy balance, it is evident that water requirements can be calculated accurately only by employing data on the heat balance of the earth's surface. Such a method of calculation has been used in a number of studies and has made it possible to construct maps of irrigation-water requirements for the arid regions of the Soviet Union.

The use of heat-balance data also makes it possible to solve another essential problem involving the planning of irrigation measures in arid regions. The use of such data in calculating the transformation of the lower layers of the atmosphere makes it possible to determine the change in the temperature and humidity of the air over irrigated oases. This yields quantitative indices of the change in the climatic conditions of desert regions as a result of irrigation measures.

In areas with moderately deficient moisture, tree windbreaks can be of great importance in improving natural conditions. The use of data on the heat balance of fields sheltered by windbreaks makes it possible to evaluate the effect of such measures on soil moisture and to draw a number of conclusions about their hydrometeorological effectiveness.

Information on the heat balance may be of equal significance in planning reclamation measures in areas of excessive moisture. Data on the heat balance make it possible, in particular, to calculate evaporation from swamps and to estimate how the climatic conditions of the surface layer of the air will change after draining of the swamps. Such calculations can also be made to estimate the effect of tall shelter-crop plantings on the thermal regime.

Heat-balance data are of special importance for working out measures for thawing out frozen subsoil and for melting snow and ice. All the projects of this sort, regardless of whether they relate to small-scale local actions or to extensive areas with permanent snow and ice cover, can be justified only by calculations of the heat energy balance.

It should be pointed out that, because of the rapid progress of power development and particularly the achievements in the field of the peaceful use of atomic energy, the practical possibilities of realizing major measures of this sort are expanding rapidly.

In conclusion we wish to note that the foundation for most of the work in the field of the heat balance of the earth's surface is provided by the factual data on the components of the heat balance in various geographic areas. In the last few years, as a result of the rapid development of the climatology of the heat balance, a mass of data has appeared regarding the space-and-time laws of distribution of the components of the balance. The considerable expansion of observations of the heat-balance components in connection with the IGY program and the progress in the field of improvement of indirect methods of calculating the components of the balance will make it possible in the very near future to make the available data on the heat balance substantially more detailed and accurate.

This will noticeably increase the opportunities for the use of heat-balance data both in hydrometeorological research and in working out integrated problems of physical geography.

Basic References

Ayzenshtat, B. A."The heat balance and microclimate of certain landscapes of the sandy desert," Sb. sovremennyye problemy meteorologii prizemnogo sloya vozdukha (Collection on Modern Problems of the Meteorology of the Surface Layer of the Air). Gidrometeoizdat, 1958.

Armand, D. L. "Experiment in the mathematical analysis of the relationship between the type of vegetation and the climate," Izv. Vses. Geogr. Obshch., No. 1, 1950.

Atlas teplovogo balansa (Heat-Balance Atlas). Under the editorship of M. I. Budyko, Leningrad, 1955.

Belinskiy, N. A. "On the question of the interaction of ocean and atmosphere," Met. i Gidr., No. 8, 1953.

Berlyand, M. Ye. Predskazaniye i regulirovaniye teplovogo rezhima prizemnogo sloya atmosfery (Prediction and Regulation of the Heat Regime of the Surface Layer of the Atmosphere), Gidrometeoizdat, 1956.

Berlyand, T. G. "The radiation and heat balance of the European territory of the USSR." Trudy GGO, No. 10 (72), 1948.

Budyko, M. I. "On the water and heat balances of the land surface," Met. i Gidr., No. 5, 1947.

Budyko, M. I. Teplovoy balans zemnoy poverkhnosti (The Heat Balance of the Earth's Surface). Gidrometeoizdat, 1956.

Budyko, M. I. "The temperature of the active surface and its bioclimatic significance," Sb. Sovremennyye problemy meteorologii prizemnogo sloya vozdukha, Gidrometeoizdat, 1958.

Volobuyev, V. R. "Investigation of the soil-hydrology relationships," Izv. AN SSSR, ser. geogr., No. 6, 1958.

Gal'tsov, A. P. Analiz klimatoobrazuyushchikh protsessov (Analysis of Climate-Forming Processes). Izd. AN SSSR, 1957.

Grigor'yev, A. A. "Some results of the elaboration of new ideas in physical geography," Izv. AN SSSR, ser. geogr. i geof., No. 2, 1946.

Grigor'yev, A. A. "Geographic zonality and some of its laws," Izv. AN SSSR, ser. geogr.,No. 5, No. 6, 1954.

Grigor'yev, A. A. and Budyko, M. I. "On the periodic law of geographic zonality," Dokl. AN SSSR, Vol. 110, No. 1, 1956.

Grigor'yev, A. A. and Budyko, M. I. "Classification of the climates of the USSR," Izv. AN SSSR, No. 3, 1959 (See Soviet Geography, May 1960, pp. 3-24).

Dzerdzeyevskiy, B. L. "The heat balance and microclimate of the liman and dry steppe of the Caspian," Izv. AN SSSR, ser. geogr., No. 2, 1954.

Izmeneniye klimata v svyazi s planom preobrazovaniya prirody zasushlivykh rayonov SSSR (Changing the Climate in Conjunction with the Plan for Transformation of the Nature of the Arid Regions of the USSR). Gidrometeoizdat, Leningrad, 1952.

"Integrated Expedition of the Hydrometeorological Service to Pakhta-Aral in 1952," Trudy Gl. Geof. Obs., No. 2, 39 (101), 1953.

Kuz'min, P. P. "A method of determining the maximum intensity of snow thaw," Trudy Gos. Gidr. Inst., No. 24 (78), 1950.
Ogneva, T. A. Nekotoryye osobennosti teplovogo balansa deyatel'noy poverkhnosti, (Some Characteristics of the Heat Balance of the Active Surface), Gidrometeoizdat, Leningrad, 1955.
Rakipova, L. P. Teplovoy rezhim atmosfery (The Heat Regime of the Atmosphere). Gidrometeoizdat, 1957.
Sapozhnikova, S. A. "A characterization of certain peculiarities of the heat balance of the wheat field in application to the agricultural evaluation of climate," Probl. fizich. geogr., No. 13, 1948.
Sapozhnikova, S. A. "The heat balance of the active surface in the main geographic zones of the USSR," Trudy Vtorogo Vses. geogr. s"yezda, Vol. II, 1948.
Seryakova, L. P. "Determination of evaporability and calculations of irrigation water requirements," Izv. AN SSSR, ser. geogr., No. 6, 1957.
Skriptunova, L. I. "On the role of the heat balance of the surface in the regime of water temperature in the northern part of the Atlantic Ocean," Met. i Gidr., No. 7, 1957.
Timofeyev, M. P. "The Heat Balance of Water Bodies and Methods of Determining Evaporation," Sb. Sovr. problemy meteorologii prizemn. sloya vozdukha, Gidrometeoizdat, 1958.

THE WATER BALANCE OF THE LAND

By M. I. L'vovich

(Abstract: The article gives a quantitative evaluation of the elements of the hydrologic cycle (precipitation, runoff, evaporation) for the earth as a whole, for natural geographic zones of the USSR (tundra, tayga, steppe, desert) and for types of land within a given zone. The role of man in altering the water balance of individual territories through reclamation measures (irrigation, drainage, plowing up of virgin land) and through changes in agricultural techniques is also discussed.)

Although the present period of the history of the development of research on the water balance already covers several decades, the water-balance problem is acquiring ever greater significance and is attracting ever greater attention. This is explained by the fact that the rapid growth of the national economy has made the water-balance issue one of the important practical problems. There is a great deal of water on earth, and its reserves appear to be inexhaustible. However, if one takes into account the unevenness of distribution of water resources in space and time and the concentration of the economy, often in regions insufficiently supplied with water, the significance of the correct use of the water balance and of the relationship between water and the economy becomes understandable.

Table 1

Water Balance of the Globe

Elements of the balance	yearly volume in cu. km.	yearly layer, in mm.	in % of precipitation of entire globe	in % of precipitation of parts of globe
Peripheral part of the land (117,628,000 sq. km.)				
Precipitation (P_2)	101,000	860	19.4	100
Stream runoff (R_2)	35,560	302	6.8	35.2
Evaporation (E_2)	65,440	558	12.6	64.8
Enclosed part of the land (31,000,000 sq. km.)				
Precipitation (P_3)	7,400	240	1.4	100
Evaporation (E_3)	7,400	240	1.4	100
Oceans (361,455,000 sq. km.)				
Precipitation (P_1)	411,600	1,140	79.0	100
Inflow of stream waters (R_1)	35,560	100	6.8	8.6
Evaporation (E_1)	447,160	1,240	85.8	108.6
Globe (510,083,000 sq. km.)				
Precipitation ($P_.$)	520,000	1,020	100	100
Evaporation ($E_.$)	520,000	1,020	100	100

That relationship does not remain constant. It fluctuates with fluctuations of climate and as a result of economic activity.

In a short paper it is impossible to treat all aspects of the water-balance problem; hence, we shall confine ourselves to a general characterization of the problem for the earth as a whole, discuss the water balance of individual geographic zones and deal in greater detail with the intra-zonal characteristics of the water balance.

In the hydrologic cycle, streams, like the atmosphere, transfer and distribute the water on the land and are the routes by which water returns to the ocean.

The total discharge of the streams of the earth, estimated from the stream-discharge map (L'vovich, 1945), which has been refined in recent years, amounts to 36,500 cu. km. a year. The bulk of this discharge reaches the ocean, while only 2.5% is accounted for by closed inland drainage areas. With a total annual global precipitation of 520,000 cu. km., as computed from O. A. Drozdov's map, the stream runoff thus amounts to only 7%. If the discharge of all the streams were spread over the surface of the oceans, a 100 mm. layer of water would be obtained, which is less than 9% of the precipitation on the surface of the oceans. While thus occupying an insignificant place in the water balance in terms of magnitude, the runoff is nevertheless an important element of the hydrologic cycle on earth and has enormous significance in the life of man.

Precipitation data for various parts of the globe and data on the runoff for the peripheral and enclosed parts of the land serve as a basis for an approximate quantitative characterization of the elements of the hydrologic cycle (Table 1).

It is evident that the inflow of 35,560 cu. km. of stream waters into the ocean corresponds to the balance of the atmospheric moisture between the ocean and the land. This is the final difference in the atmospheric moisture exchange of the two great parts of the earth. The total amounts of moisture carried by the atmosphere from sea to land and from land to sea are much greater. These amounts have not yet been determined, but the stream runoff makes it possible to estimate their difference.

Quantitative evaluation of the atmospheric moisture exchange between parts of the land is possible from the data of aerological observations of the velocity of the wind and the moisture content in the air.

Such an estimate has been made by Kh. P. Pogosyan (1952) for the European territory of the USSR and its parts. One of the tasks of further research is to make similar calculations for characteristic territories that will make it possible to establish the characteristics of the hydrologic cycle for individual geographic zones and for intrazonal conditions.

The water balance of a limited territory, for example, a river basin, is characterized by the expression:

$$P = S + U + E,$$

where P is the precipitation, S the surface component and U the underground component of the stream runoff, and E the evaporation, including transpiration.

This expression differs from the well-known Penck-Oppokov equation only in that the stream runoff is broken down into the main sources of feeding. Now it is possible to determine with more or less certainty the basic components of the stream runoff; therefore it appears to us that we should try to apply a more differentiated equation of the water balance even though its solution may still be approximative.

From the preceding expression it follows that: $P - S = W$; $W = E + U$; $K_u = \frac{U}{W}$; $K_e = \frac{E}{W}$, where W is the total soil moisture, i.e., the annual amount of water absorbed by the soil and lost to evaporation (E) and in feeding the ground-water delivery (U) to streams; K_u is the coefficient of ground-water delivery to streams and K_e is the coefficient of evaporation, both of which characterize the relationship between the two components of the loss of water moistening the soil during the year.

The various geographic zones are each characterized by distinctive magnitudes and relationships of the water-balance elements.

In the tundra, the small amount of heat limits evaporation; the permafrost limits the ground-water discharge to streams and increases the surface runoff. The ground-water discharge coefficient is less than 0.1, while the surface runoff coefficients are high (0.7-0.8).

In the tayga, in the regions where permafrost is absent, the ground-water discharge to streams increases sharply (K_u - 0.25-0.40), the loss to evaporation (250-300 mm.) is increased both by greater evaporability and by greater transpiration capacity of the forest. For the Siberian part of the tayga zone, within the limits of permafrost, precipitation decreases because of greater continentality. Permafrost sharply reduces the ground-water discharge so that almost all the soil moisture is lost to evaporation. The ground-water discharge coefficient therefore has values typical of the forest-steppe zone (0.05-0.10), but with the high surface runoff coefficients (0.5-0.7) peculiar to the tayga zone.

In the mixed-forest zone the favorable relation between heat and moisture causes a large loss of soil moisture to evaporation (350-450 mm.); the ground-water discharge coefficient drops to 0.10-0.20, and the surface runoff coefficients to 0.30-0.40.

Table 2

Examples of the Water Balance of an Area for Various Geographic Zones

Zone	River basin	Precipitation P in mm.	Runoff in mm. full R	whereof: surface S	underground U	Evaporation E mm	Total soil moisture W mm	Coefficients of: ground-water discharge K_u	evaporation K_e	runoff K R
Tundra	Much'ya	450	340	330	10	110	120	0.08	0.92	0.76
	Amguema	350	255	247	8	95	103	0.08	0.92	0.73
Tayga	Pinega	500	344	250	94	156	250	0.38	0.62	0.69
	Vym'	530	314	238	76	216	292	0.26	0.74	0.56
Tayga with permafrost	Vilyuy	360	210	194	16	150	166	0.10	0.90	0.58
	Olenëk	400	195	185	10	205	215	0.05	0.95	0.49
Mixed forest	Berezina	610	180	108	72	430	502	0.14	0.86	0.30
	Klyaz'ma	580	210	160	50	370	420	0.12	0.88	0.36
Forest steppe	Psel	490	74	53	21	416	437	0.05	0.95	0.15
	Oka	540	130	100	30	410	440	0.07	0.93	0.24
	Medveditsa	410	78	62	16	332	348	0.05	0.95	0.19
Steppe	Ingulets	435	37	30	7	398	305	0.02	0.98	0.09
	Sal	350	30	26	4	320	324	0.01	0.99	0.09
	MalayaUzen'	300	36	32	4	264	268	0.01	0.99	0.12
Semi-desert	Turgay	200	10	9	1	190	191	0.005	1.0	0.05
	Sary-Su	180	4	4	0	176	176	0	1.0	0.02

In the forest-steppe, by comparison with the forest zone, there is a substantial increase in the relative values of the surface runoff. Considering the deficiency of soil moisture, this represents under these conditions a useless source of water consumption, and, considering the floods and erosion caused by it, constitutes an unfavorable element of the balance. By virtue of the high evaporability, the loss of water to evaporation is considerable, and the ground-water discharge coefficient drops to 0.05-0.10, and the runoff coefficients to 0.15-0.25.

In the steppe zone, with high evaporability, the actual evaporation, limited by precipitation and soil moisture, diminishes to 250-400 mm., but it constitutes 97 to 99% of the total soil moisture. The ratio between the surface and underground components of the stream runoff is even less favorable. The part of the stream runoff most valuable for the national economy constitutes 10 to 20% of the full amount. The ground-water discharge coefficients drop to 0.01-0.02, and the runoff coefficients to approximately 0.1.

In the semi-desert, a large part of all precipitation is lost on moistening the soil and to evaporation. The runoff coefficients drop to 0.01-0.05, and the streams are virtually not fed at all by ground waters.

The typical features of the water balance of an area in various geographic zones have not yet been sufficiently studied, and the characterizations given are schematic in character (Table 2).

There exists an organic relationship between the water and heat balance. From this relationship stems Academician A. A. Grigor'yev's theory of the amounts of heat and moisture and their relationships as the basic factors of geographic zonality.

A. A. Grigor'yev (1954) proposed that for the quantitative characterization of geographic zones use be made of M. I. Budyko's radiation index of dryness (1948), and established its values as follows: boundary between tundra and tayga 0.35; boundary between the subzones of the southern and middle tayga 0.6; boundary between the zone of broadleaf forests and the forest-steppe 0.9. According to M. I. Budyko (1956), the ranges of values of this coefficient are as follows: tundra less than 0.33; forest zone 0.33-1.1;steppe 1.1-2.3; semi-desert 2.3-3.4; desert more than 3.4 As another index of geographic zonality, Grigor'yev (1958) proposed the values of the ratios of the loss of heat to evaporation to its loss in turbulent exchange. These energy indices characterize the total moisture supply: in regions of excess moisture the loss of heat to evaporation is considerably greater than in turbulent heat exchange; in the highly arid regions, much less heat is lost to evaporation than in turbulent heat exchange.

M. I. Budyko (1956), as a result of his theoretical research of the heat balance, has established an organic connection between the radiation balance, the radiation index of dryness and the zonal magnitudes of stream runoff.

The stream-runoff magnitudes determined on the basis of these relationships and the values of the runoff coefficients agree well with observed data.

This research, which represents a great contribution to the development of the theory of heat and moisture as factors of the formation of the geographic environment, is being continued by the institutes of the Academy of Sciences of the USSR and of the Hydrometeorological Service under the topical problem in the plan of the Academy of Sciences of the USSR titled: "The heat and water regime of the earth's surface, its role in the dynamics of natural phenomena and methods of transforming it for practical purposes" ("New Program.., "1958).

One of the tasks involved in this problem is the study of the intra-zonal laws of the heat and water balance for the purpose of creating the scientific theoretical foundations for regulating the heat and water balance in the direction most beneficial to the economy.

For economic purposes it is important to know not only the typical water balance representing an integral characterization of a given zone, but also the water balance of individual intra-zonal territorial units. For example, in the forest or forest-steppe zones, the magnitudes and relationships of the individual elements of the water balance evidently differ for forested areas and cropped fields. The difference is due to the character of the mesoclimate and the microclimate of these two land types and to the difference in the magnitudes of the elements of both the heat and water balances. Another important factor in the intra-zonal characteristics of the water balance is the soil cover. The soil on different types of land possesses different infiltration and water-holding capacities, which in turn govern the magnitudes of the full runoff, its surface and underground components, as well as the loss of soil moisture to evaporation. A substantial role in the formation of the water balance is also played by the plant cover, both as a factor of soil formation and as a source of loss of soil moisture in transpiration.

As an example characterizing the difference in the water balance of the two types of land of the mixed-forest zone, we present the latest data observed by the Institute of Geography in the Moscow region (Table 3).

The receipts part of the balance (snow reserves + precipitation) in the forest is 35 mm. greater than in the clover field because of better snow retention.

Because of the higher infiltration capacity of the soil cover, the total soil moisture in the forest is over 100 mm. more, or twice as high, and the surface runoff is nearly 70 mm. less, or 3 times lower, than in the clover field. It is characteristic that the change in the moisture reserves in the 1.5 m. layer of soil during the snow-thaw period is nearly equal on both types of land, but the greater permeability of the forest soil enables three times as much water to percolate down (to a depth of more than 1.5 m.) than in the field. This shows a more intensive feeding of soil and ground

waters in the forest and consequently a more favorable relationship between the elements of the water balance on this type of land.

Table 3

Elements of the Water Balance during the spring of 1958 and 1959 in the Moscow Region

Land type	Snow reserves + precipitation mm.	Surface runoff mm.	Total soil moisture mm.	Change in moisture reserves in 1.5 m. layer of soil mm.	Percolated to a depth of more than 1.5 m. mm.
Forest	240	34	206	61	145
Clover (2nd and 3rd year of use	205	102	103	55	48

The stream runoff as an element of the hydrologic cycle and especially the water balance of individual areas are not formed under the influence of the natural physical-geographic factors alone. A greater or lesser role belongs to the activity of man.

The total withdrawal of water for irrigation amounts to more than 1,000 cu. km. a year, of which approximately 1/3 returns to the streams and feeds the ground-water supply. Other sources of withdrawal must also be taken into account: urban, rural and industrial water supply, evaporation from reservoirs, and so forth. Altogether, the amount of unreturned water taken from streams and ground-water apparently reaches magnitudes of the order of 1,000 cu. km. a year for the globe, which amounts to about 3% of the total stream runoff. The loss of water to evaporation from the land has increased accordingly.

In relation to all the water resources of the land the consumption of water on the globe is still insignificant, but in certain regions the effect of economic activity on the water balance is quite substantial. For example, in China the consumption of water for irrigation reaches magnitudes of the order of 500 cu. km. a year, about 18% of the total stream runoff in that country. About half the volume of the runoff of the Nile River is used for irrigation. Approximately as much is drawn from the Syr-Dar'ya, but in this case the percentage of returned water is considerable. There are apparently also other sources compensating for the water withdrawn for irrigation. Very considerable is the consumption of water for irrigation from the Aras, Yellow River, Indus, Ganges, Shatt-al-Arab, Murray, Colorado, and others.

The water balance is substantially affected not only by irrigation farming. Non-irrigation farming in certain regions also plays a perceptible role in the formation of the water balance. The general tendency of modern farming is an increase in crop yields. This is accomplished by applying improved tilling methods, fertilizers, crop rotation, windbreak plantings and other measures. The water-balance significance of these measures consists in an additional moistening of the soil through diminution of surface runoff and in an over-all increase in evaporation, with a relatively greater growth of productive evaporation (through transpiration) and with a relative reduction of non-productive evaporation (directly from the soil).

For example, experimental investigations in Kamennaya Step' (Stone Steppe) in 1950 have shown that the total loss of water to evaporation during the growing period of spring wheat in the open steppe amounted to 173 mm., with a loss of 84 mm. of water through transpiration and 89 mm. directly from the surface of the ground, but the figures were 217, 137 and 80 mm., respectively, in fields sheltered by windbreaks and cultivated by improved techniques. In this case, the total loss of soil moisture increased by 44 mm. as a result of the measures taken to raise farm productivity, with a 53 mm. increase in productive evaporation and a 9 mm. reduction in non-productive evaporation. In the first case, the productive evaporation amounted to 48% of the total; in the second, to 63%.

A similar experiment in irrigated fields (Yershov Rayon, 1953) has shown that in a field sheltered by windbreaks the consumption of water by spring wheat was 22% higher than in the open steppe, and the non-productive evaporation 27% lower.

Additional moistening of the soil through retention of surface runoff, especially in steppe and forest-steppe regions, is accomplished by a number of techniques, including autumn plowing, which was hardly employed before the era of kolkhoz farming but has become widespread in recent years. A number of experiments (Garyugin 1955, Zhigalov 1955, Kuznik 1958, L'vovich 1957, Nazarov 1957, Onufriyenko 1956, Uryvayev 1958, and others) have established that a considerable diminution of spring surface runoff and a corresponding additional moistening of the soil are achieved by autumn plowing. The zonal regularity of the reduction of surface runoff due to this technique is characteristic (Table 4).

The relative water-retaining effect of autumn plowing is reduced with an increase in the total moisture supply, but the amount of water additionally accumulated in the soil is increased.

Substantial changes in the water balance of a territory have resulted from the plowing up of huge areas of virgin and idle lands in the last few years in Northern Kazakhstan, Western Siberia and the Transvolga. The plowland area in some oblasts has increased from 10-20% to 30-50% in a 3-4-year period. The water-balance effect of this measure may be judged from the fact that, with the normal use of autumn plowing (60-70% of the plowland area),

the surface runoff from the whole plowed area of former idle or intensively grazed-over virgin land diminishes by 2-2.5 times, but after plowing slightly grazed virgin land the runoff remains unchanged or diminishes by 10-20%.

Table 4

Zonality of the Diminution of Surface Runoff due to Autumn Plowing

Zone	Diminution of runoff by "x" times	Diminution of runoff and additional moistening of soil in mm.
Dry steppe	4-7	15-30
Steppe	2.5-4	25-40
Forest-Steppe	1.5-2	30-50
Zone of mixed forests	1.2-1.5	30-60

A considerable role in the regulation of the water balance of a territory is played by windbreaks, especially if they are in the form of a system of shelter belts protecting the crop-rotation fields. In addition to regulating evaporation and the relationship between its productive and non-productive components, the shelter belts, planted across the slopes (with a deviation of up to 30-40° from the general direction of the contours) are known to be capable of detaining surface runoff. Experimental data have established that their water-detaining capacity fluctuates between 2,500 and 5,000 cu. m. per hectare of tree plantings, depending upon their width. One must further take into consideration the more intensive feeding of ground waters within the forest belts compared with the open steppe.

A good deal of data has also appeared on the water-balance effectiveness of afforestation in foreign countries. The magnitude of experimental investigations is especially great in China in conjunction with the realization of plans for transforming nature in the Yellow River basin and in other regions. These experimental data, widely verified under production conditions, have established that improvement of agricultural techniques, with the application of furrowing, the embanking of the brows of ravines and the setting up of water traps along the roads virtually stops the entry of surface water into the ravine network. Terracing and foresting of the slopes of ravines, as well as the building of ponds in the ravines, diminishes the surface runoff from the drainage network by approximately 2-3 times.

As a result of experimental studies in 150 catchment basins in Rumania, it has been shown that mulching of potatoes under Transylvanian conditions diminishes the runoff by 1.5 times, and winter-cropping and grass sowing by 3 times.

In India (Punjab and Northern Dekkan) experimental studies of runoff from fields using different tillage techniques have made it possible to establish that under downpours of 137 mm. (in 4 hours) and 238 mm. (in 19 hours) grass sowing (clover) reduces runoff by 3 to 15 times compared with uncultivated fields.

A great deal of data regarding the effect of agricultural techniques on the water balance and runoff have been accumulated in the United States. According to these data, the introduction of proper crop rotations in Missouri diminishes the runoff by 2 times, and the regulation of stock grazing by 2 to 3 times. In other states experiments have established that terracing diminishes runoff by 2 to 9 times, depending upon the character of the terraces and the local conditions. Cook, on the basis of experiments, estimates the diminution of the total stream runoff under the influence of modern farming measures at 52% on the deep soils of the United States, and at 32% on the thin soils.

I. Walner has established for Germany that the increase in crop yield during the past 70 years has raised the evaporation from fields by 70 mm. and correspondingly diminished the stream runoff.

Great possibilities for water-balance regulation are latent in the proper exploitation of forests. Investigations in the last few years have shown that the prohibition of logging in certain categories of water-conserving forests not only restricts the utilization of the forest wealth, but in a number of cases also reduces the water-conserving properties of the forest. On the other hand, if we consider that the principal water-conserving component of the forest biogeocoenosis is the soil cover, the proper course to insure the preservation of the water-regulating properties of forests becomes clear. For this purpose, there is no justification for closing some forests (for example, fringing forests along rivers) while opening other forests -- over most of a river watershed -- to logging, which often does not insure the renewal of the forest and sharply reduces its water-conserving role. However, there are also logging methods that do not disturb the water-conserving properties of the forest and sometimes even increase them.

All forests are water-conserving, but at the same time the forest, as one of the sources of natural wealth, should be exploited for timber. Legislation on water-conserving forests should therefore not be directed toward the prohibition of logging but toward the employment of logging methods that furnish timber to the national economy and at the same time insure the water-conserving action of the forests. Conflicts between the water-conserving function of the forests and logging exist only because logging is at present being done improperly: it results in grave injury to the forest soil cover, reducing its infiltration properties and often causing the cut-over areas to become water-logged, and does not provide for the renewal of the forest; or, if it is renewed, it is with low-grade secondary growth. Proper logging is not in conflict with the maintenance of the water-conserving properties of the forest if it is done within the limits of the natural new growth according

to strict systems differentiated for different conditions and if it insures the natural or artificial renewal of the forest. This requires the use of mechanical means that will preserve the soil from injury: aerial log-hauling or hauling in winter over the snow, and so forth. It appears to us that the system of water-conserving forests created 23 years ago in the USSR on the basis of other principles has served its purpose and that the time is now ripe for a complete reconstruction of this system on the basis of new principles suggested by science and practical needs.

Another effective means of regulating the water balance of a territory in the zone of excess moisture is reclamation by drainage. The swamps of the temperate zone are sources of stable evaporation, which in general causes a diminution of stream runoff. The draining of swamps and waterlogged lands lowers the loss of water to evaporation, consequently increases the runoff and affects the distribution of the runoff within the year. A good example is provided by Hungary. In the second half of the 19th century, 24% of the territory of Hungary was still subject to flooding by rivers. Large areas of the Tisza and other river basins were occupied by swamps and waterlogged lands, which uselessly evaporated a considerable amount of stream water. After the execution of great reclamation projects - the diking of rivers, the creation of a dense network of drainage ditches and canals, with mechanical pumping of water over jetties (300 pumping stations operate for this purpose) all the waterlogged lands became suited for farming and the high-stage and low-stage discharges of the Tisza River have grown perceptibly.

Here we have an example of the transformation of the water balance of a territory that has substantially affected the water regime of a large stream.

Other examples of changes in stream regimes under the influence of farming are the streams of the steppe and forest-steppe regions of the USSR, in whose basins nearly half the area is now autumn-plowed. This measure, which substantially diminishes the slope runoff, as well as a number of other measures for raising farm productivity, have reduced the annual stream discharge by approximately 8 to 12% (Don, Sosna, Khoper, Oskol, Oka and other rivers) and 15 to 25% (Medveditsa, Chir, Kalitva, Sal and other rivers), with a greater reduction of the spring discharge and a certain increase in the low-stage discharge.

In China, as a result of the program of measures for raising farm productivity and controlling erosion on the Loess Plateau, the total eventual reduction of discharge in the Yellow River is estimated at 25%, the discharge of the river having already been reduced by at least half that amount. Thus on the Man Ho (a tributary of the Yellow River), with a basin area of 650 sq. km., observations have established that the increase in water level caused by a four-day downpour of 245 mm. was reduced by 58 mm. as a result of the reclamation measures, that is, by 24% compared with the rise observed on that river after the same kind of downpour before the reclamation measures. It is interesting to note that 57% of the total volume of flood waters detained is accounted for by improved field techniques, 28% by new "echeloned" forest plantings, 11% by new reservoirs and 4% by other measures.

A perceptible diminution of stream discharge as a result of the raising of the level of farming has been revealed on certain rivers of Poland (Noteć River 38%) and Germany (Lippe River by 48 mm. or 9%).

All these examples illustrate the big role played by reclamation measures in the transformation of the water balance of a territory and the regime of streams. It is important to emphasize the increasing significance of the economic factor in the shaping of the water balance.

The growth in farm productivity is accompanied by an increase in water consumption in regions of insufficient and of optimal moisture supply. Reclamation by drainage saves a considerable amount of water from useless evaporation in regions abounding in swamps and waterlogged lands. The possibilities for the further development of reclamation methods and their wider application are still far from exhausted. As a matter of fact, only comparatively recently has the ground been laid for a deliberate regulation of the water balance in the direction necessary to eliminate its negative aspects. We emphasize "deliberate" because this has become possible on the basis of data from experimental study of changes in the elements of the water balance, that is, on the basis of a quantitative evaluation of these changes. Experimental investigations of the intra-zonal (e. g. economic) factors of the formation of the water balance are disclosing new prospects for its regulation and make it possible to steer it in the direction needed by the economy. Nevertheless, we must remember that the experimental study of the formation of the water balance does not yet embrace the whole range of natural and economic conditions; one of our future tasks is the fullest development of these investigations.

The time has undoubtedly come to consider the transformative effect of reclamation upon the water balance in planning the utilization of water resources. Such planning must be done from a long-range point of view. For this reason, it is necessary not only to know the changes that have already taken place in the water balance, but also to anticipate their planning for the future. This plan should take into consideration both the "visible" consumers (water supply, irrigation, and so forth), and the "invisible" ones (consumption of water in the fields, forests and so forth). The long-range planning of both types of consumption, especially the invisible kind, is no simple matter and requires proper scientific investigations and organizational measures.

It seems to us that the time has come to create a water-balance cadaster of the USSR, similar to those in Czechoslovakia, Poland, Hungary and other countries. These cadasters include an integrated analysis of the present water balance, ranging from comparatively small intra-zonal territorial units to individual land uses, take stock of the resources of surface and ground waters and all of the present water consumers, and note the prospects for further water use. Such an integrated water-balance cadaster is also needed for the USSR. The national economy requires it especially for economic regions with a tight water balance, where further development is largely limited by the water resources.

One cannot regard as justified the isolated planning of the utilization of water resources for separate branches of the economy. Only an integrated water-balance inventory and an integrated planning of water resources can insure their rational utilization in accordance with the requirements of the national economy, which is developing with gigantic strides in the Soviet Union.

References

Budyko, M. I. Ispareniye v yestestvennykh usloviyakh (Evaporation Under Natural Conditions). Leningrad, Gidrometeoizdat, 1948.

Budyko, M. I. Teplovoy balans zemnoy poverkhnosti (The Heat Balance of the Earth's Surface). L., Gidrometeoizdat, 1956.

Budyko, M. I., and others. Izmeneniye klimata v svyazi s planom preobrazovaniya prirody zasushlivykh rayonov SSSR (The Changing of the Climate in Conjunction with the Plan for the Transformation of the Nature of the Arid Regions of the USSR). L., Gidrometeoizdat, 1952.

Garyugin, G. A. "Spring runoff in its dependence upon the condition of the surface of the soil," Meteorologiya i gidrologiya, 1955, No. 3.

Grigor'yev, A. A. "Geographic zonality and some of its laws," Izvestiya Akademii nauk SSSR, ser. geograf., 1954, Nos. 5 and 6.

Grigor'yev, A. A. "On some geographic laws of heat exchange and water exchange on the land surface and on ways of further studying the exchange of matter and energy in the geographic environment," Izvestiya Akademii nauk SSSR, ser. geograf., 1958, No. 3.

Zhigalov, I. I. "The effect of soil cultivation upon the slope runoff of melt waters," Pochvovedeniye, 1955, No. 10.

Kuznik, I. A. Obosnovaniye gidrologicheskikh raschetov pri proyektirovanlii vodokhozyaystvennykh meropriyatiy v Povolzh'ye (Hydrologic Calculations in the Planning of Water-Management Measures in the Volga Region), Saratov, 1958.

Nazarov, G. V. "Analysis of stream discharge factors in connection with the evaluation of the effect of economic activity upon it in the Southern Transvolga." Izv. AN SSSR, seriya geogr., 1957, No. 6.

L'vovich, M. I. Elementy vodnogo rezhima rek zemnogo shara (Elements of the Water Regime of the Streams of the Globe), Gidrometeoizdat, 1945.

L'vovich, M. I. "On the role of farming in the formation of the water regime of streams," Voprosy gidrologii (Problems of Hydrology), published on the occasion of the 75th birthday and the 50th anniversary of the scientific, pedagogic and productive activity of Ye. V. Bliznyak. Moscow State University, Geography Faculty, 1957.

"New program of investigations on the problem of the heat and water regime of the earth's surface, its role in the dynamics of natural phenomena and methods of transforming it for practical purposes," Izv. AN SSSR, seriya geogr., 1958, No. 6.

Onufriyenko, L. G. "Some data on the effect of agrotechnical measures on slope runoff," Tr. Ukrainsk. nauchn.-issled. gidrometeorol. in-ta, No. 6, 1956.

Uryvayev, P. A. "The effect of autumn plowing on the runoff of melt waters," Meteorol. i gidrol., 1958, No. 7.
Dubrowin, T. and Rogiński, S. "The effect of farming and forestry on the water balance of the runoff of the Noteć River as far as the mouth of the Gwda" (in Polish), Gospodarka Wodna, 1954, 14, No. 11.
Kalweit, H. "The effect of the increase of farm and forestry yield per hectare on the water economy," (in German), Wasser und Boden, 1955, No. 3.

THE WORK OF THE INSTITUTE OF GEOGRAPHY OF THE ACADEMY OF SCIENCES OF THE USSR IN 1959

By D. V. Kravchenko

The institute did a great deal in the first half of 1959 to improve its scientific research activities. Guided by the directives of the general assembly of the Academy of Sciences concerning the concentration of forces on the most important theoretical and practical studies and the elimination of outdated topics, especially those of a narrow regional character, from the research program, the institute reviewed its research plan and, besides eliminating several topics, made substantial changes in the content of many others and included new topics.

The main problems included in the institute's research plan for 1959 were the following:

1. Geography of the USSR and foreign countries. Work on this problem included the writing of regional descriptions of republics and major economic regions of the USSR, as well as of foreign countries, both people's democracies and capitalist countries. This work is based on the generalization data already accumulated in the literature and the assembling of additional data obtained during field work in the study areas. This work was further expanded and deepened during 1959.

2. Integrated geographic research in areas of new economic development, designed to study natural conditions and to determine and assess the natural resources in connection with the development of the productive forces of these areas.

3. The heat and water balance of the earth's surface, its role in the dynamics of natural processes and methods of transforming it for practical purposes. Work on this problem consists of research by field parties and by experimental field stations set up in various physical-geographic zones of the USSR. Besides the Institute of Geography, this research has been joined by other institutions, notably the Hydrometeorological Service, and by the academies of sciences of union republics and the Siberian Division of the Academy of Sciences USSR. During 1959 work on this problem was expanded and given a more purposeful character. In connection with this problem the institute engaged in research under the program of the International Geophysical Year as it affected glaciology and, in part, climatology.

In addition to work under these three headings, the institute engaged in research of a long-term theoretical, methodological and historical character as well as in assignments of a scientific-practical nature received by the institute.

The over-all volume of activity of the institute was further expanded in 1959. This was reflected in an increase of the staff and an expansion of the range of research topics and publishing activity.

Ties between the scientific research of the institute and practical requirements continued to be strengthened. This was evident in the fact that more institute staff members than previously were drawn into the work of the commissions and other bodies of the State Planning Committee (Gosplan) USSR. In particular, the institute took active part at the end of 1959 in the preparation of several sections of the long-term plan of economic development of the USSR. The institute was also engaged in joint work of a scientific-practical character with the Main Administration of Geodesy and Cartography and with the Main Administration of the Hydrometeorological Service. A large part of the institute's work was published through the Geographical Publishing House. However the ties thus far achieved between scientific work and practical needs can still not completely satisfy the institute. Its ties are inadequate, for example, with the Ministry of Geology and Resource Conservation and with the Ministry of Agriculture, i.e., agencies with whom close collaboration would make possible the direct introduction of scientific geographic knowledge into important spheres of utilization (and study) of natural processes.

The institute achieved certain results in 1959 in developing modern geographic research methods and, particularly, in enriching descriptive methods with more precise quantitative data, especially in cartography (aerial photostereogrammetry), glaciology, chemical analysis and climatological calculations.

The institute's report for 1959 was submitted by I. P. Gerasimov, institute director, at a meeting of the Council at the end of December 1959. Subsequently the report was thoroughly discussed at departmental meetings of the institute. Both the director's report and the following discussion noted the considerable results achieved by the institute in 1959 on a number of topics.

In conjunction with the academies of sciences of union republics and with some universities, work continued on regional monographs on union republics and major economic regions of the USSR and on the people's democracies and capitalist countries.

The institute made substantial changes in the publication program of its series on the physical geography of the USSR with a view to reflecting more broadly problems of the rational utilization of natural resources. Work continued on the books dealing with the natural conditions of Western and

Middle Siberia, Yakutia and Transbaykalia; work was started on the volumes dealing with the European North and the Caucasus. A geomorphic map of the USSR at the scale of 1:4,000,000 was published.

Continuing the preparation and publication of economic-geographic monographs on the USSR, the institute published the 15th volume of that series (general survey of the Urals) in 1959; completed for the press the volumes on Eastern Siberia, the regional survey of the Urals, the central oblasts of European Russia (in three volumes), and continued work on the monographs dealing with the North and Northwest of European Russia and the Far East. At the same time preparations began for a new series that will differ from the previous in the deeper analysis of the basic economic objectives of the study area under the long-term plan of development.

A large monograph on the economic geography of Germany (the German Democratic Republic and the Federal Republic of Germany) was published in 1959. Work was completed on a collection of articles on the economic geography of some regions of the Chinese People's Republic (Shantung, Sinkiang Uigur Autonomous Region, the Southern Coastal Region). Work was also virtually completed on large geographic monographs dealing with Rumania and Bulgaria, written jointly with geographers of those two countries. Chinese and Soviet geographers completed several years' joint field work on the natural conditions of Sinkiang. Some results of that work have already been published in China. Work is continuing on the publication of the results in Chinese and in Russian.

In previous years the institute published several books on the geography of capitalist countries. In 1959 it published a book on East Pakistan, sent a study on Mexico to the printers, and continued to prepare for the press books on Indonesia, Egypt and Argentina.

As for its work on the integrated geographic study of areas of new economic development, chiefly in Siberia and the Far East, the institute conducts it as a rule as a part of field parties organized by the Council for the Study of Productive Forces of the Academy of Sciences USSR. In 1959 the institute devoted its main attention to preparation of the results (reports, articles for the press, papers delivered at various conferences, notes for future papers, maps, and so forth) of field work done in Krasnoyarsk Kray, Chita Oblast and areas of the Amur basin (the latter jointly with the Chinese). Work continued on the study of the geomorphology and Quaternary deposits of the Lena valley in connection with hydroelectric development plans. Physical-geographic field work has begun in Kamchatka.

Important theoretical and practical results were yielded by research on the heat and water balance of the earth's surface and the dynamics of current physical-geographic processes with a view to working out methods for the utilization and transformation of such processes for practical purposes.

As stated above, the institute is conducting its research on this problem

within the framework of the International Geophysical Year (the institute is the headquarters for all IGY glaciology studies). In 1959 the institute completed its research at two glaciological stations -- Tikhaya Bay on Guker Island of Franz Josef Land, and Russkaya Gavan' on North Island of Novaya Zemlya. At its third station, on Lake Khodata in the Polar Urals, the institute completed most of its glaciological observations and, starting early in 1960, will begin a new cycle of glaciological observations on a reduced program. Analysis of the data of all three stations began at the end of 1959.

The institute participated also in IGY glaciological studies at the stations and in the field parties of other agencies: thermometric work on the glaciers of the Terskey-Alatau (with the Academy of Sciences Kirghiz SSR) and on the glaciers of the Trans-Ili Alatau (with the Academy of Sciences Kazakh SSR); glacio-geomorphic observations at the Suntar-Khayata station in the Yakut ASSR (with the Institute of Permafrost Studies of the Academy of Sciences USSR); and the Marine Antarctic Expedition. The preliminary processing of data has been completed and part has already been transmitted to the World Data Centers. In addition the institute took part in glaciological research of the Chinese Academy of Sciences in the Kunlun and the Tien Shan.

On the basis of the data obtained the institute published in 1959 three volumes of Glyatsiologicheskiye issledovaniya MGG (Glaciological Studies of the IGY) and three additional volumes were prepared for the press. Articles were also published in various periodicals.

Together with glaciological work under the IGY program, the institute also conducted meteorological and synoptic studies in the Moscow area.

Related to the glaciology work of the institute is its research on formation and dynamics of the snow cover. In 1959 the institute did field work on the distribution, dynamics and structure of the snow cover and its role in natural processes in the Trans-Ili and Kungey-Alatau mountains, in the basins of the Amur, Shilka and Argun' rivers, in Kazakhstan and in the Caucasus. The books Geografiya snezhnogo pokrova (Geography of Snow Cover) and Rol' snezhnogo pokrova v fiziko-geograficheskikh protsessakh (The Role of Snow Cover in Physical-Geographic Processes) are in press.

On the topic "Study of the regulating influence of agricultural techniques on the water balance of the area and the runoff" experimental work was done in 1959 in runoff-study areas near Zagorsk and Kursk (in the forest and forest-steppe zones).

Work also continued on the topics "The heat and water balances of cropped fields in the steppe and wooded steppe and their influence on crop yields" and "Water balance of irrigated lands."

Continuing its work on the study of erosion types in the USSR and

working out a system of preventive measures, the institute in 1959 carried out field work in the middle Volga and lower Vyatka areas and completed an erosion regionalization of Soviet territory, giving the qualitative characteristics of erosion zones and provinces in the European part of the USSR, indices for trends in agriculture and the structure of sown areas.

Having studied freshets on the territory of the USSR, the institute in 1959 published a volume titled Problemy pavodkov (Freshet Problems).

In addition to research on the three main scientific problems, the institute, as mentioned above, also continued work on several methodological and historical problems, on promising theoretical problems that have received little attention, and on special assignments of a scientific-practical character. The latter include work on the physical-geographic atlas of the world, for which the institute prepared several map sketches in 1959.

Together with the Central Scientific Research Institute of Geodesy, Aerial Photography and Cartography and several other institutions of the Academy of Sciences USSR, the academies of sciences of union republics, the Ministry of Geology and Resource Conservation, the Ministry of Higher Education, and the institutions of several regional economic councils, the institute continued its study of current tectonic movements of the earth's crust, using geophysical data. Work was conducted in the West Siberian Plain, along the second-order triangulation chains Semipalatinsk-Alma-Ata and Perm'-Kirov, in the Middle Volga Region and in the Caucasus. The work is supervised by a coordinating committee attached to the institute. In 1959 the institute also studied the paleogeography of the northwest part of the Russian Plain in Pleistocene times. The purpose of this research is to obtain a critical generalization of the literature and archival materials and to make a detailed field study of key sectors to establish the stratigraphy of Quaternary deposits in the study area.

As part of its study of the history of geography in Russia from ancient times to the present, the institute in 1959 prepared for the press a study of the history of physical-geographic research conducted in the USSR by the Academy of Sciences USSR during the period of the First Five-Year Plan (1928-32).

In addition to its own work program, the institute took part in the preparation of displays for the Exhibition of Achievements of the National Economy of the USSR; the exhibition's map of industry of the USSR was prepared on the basis of data furnished by the institute and under its direct supervision. The institute also took part in the Soviet exhibition in New York, supplying several displays reflecting the achievements of Soviet geography and the work of the institute.

In 1959 the institute organized and conducted (sometimes in conjunction with other institutions) several major meetings and conferences: on the problem of the transformation of the water and heat balance of the earth's

surface; an interdepartmental conference on the study of current tectonic movements; an interdepartmental conference on the transcription of place names; a conference on study of Pleistocene and contemporary glaciation in the Caucasus; a conference on the monograph Seli SSSR (Mudflows of the USSR). In addition to discussing the results of studies, the coordination of research and the plans for future research, these conferences also heard and discussed papers on important theoretical and practical questions.

In addition to these conferences, the Institute in 1959 took part in the Congress of Geographers of Siberia and the Far East, in the Fourth Landscape-Study Conference in Riga, in conferences on prevention of soil erosion (Khar'kov), on the heat balance (Vologda), on place names (Kiev), and on satellite towns. Staff members of the Institute presented papers and reports at all these conferences. A large number of papers were prepared by staff members for the Third Congress of the Geographical Society of the USSR.

The Institute continued in 1959 to strengthen international scientific ties. Its staff members traveled to China, Poland, East Germany, Bulgaria, Hungary, the United States, France, Australia and Ghana and the Institute welcomed geographers from Rumania, Czechoslovakia, Poland, Bulgaria, East Germany, the United States, Canada, France, West Germany, Australia, Sweden and Norway. The Institute gave much attention to preparations for the 19th International Geographical Congress.

ACTIVITIES OF THE NATIONAL COMMITTEE OF SOVIET GEOGRAPHERS (January 1959 - March 1960)

By M. B. Gornung, secretary

(From Izvestiya Akademii Nauk SSSR, seriya geograficheskaya, 1960, No. 3, Pages 138-141)

Since publication of the 1958 report of the National Committee of Soviet Geographers, the committee's activities have expanded considerably in connection with preparations for the 10th General Assembly of the International Geographical Union and the 19th International Geographical Congress in Stockholm in August 1960. In the intervening period the committee held six general meetings and several meetings of the committee's officers. At these meetings the committee discussed various aspects of the participation of Soviet geographers in the congress, in its exhibits and in the commissions, the the expansion of ties with the national committees of foreign countries and other questions.

As in previous years, Soviet geographers were regularly informed through this journal about the activities of both the International Geographical Union and the Soviet National Committee. In 1959, this journal printed the 1958

report of the committee, the material published in the IGU Newsletter and the program of the Stockholm congress. Early in 1960, at the Third Congress of the Geographical Society of the USSR in Kiev, the National Committee had occasion to report on its activities to the Soviet geographic community. The report, made by Academician I. P. Gerasimov, committee chairman, on the development of international scientific ties and their importance for the further progress of Soviet geography, was approved by the Congress. A condensed text of the report was published in No. 1, 1960, of this journal (see Soviet Geography, May 1960, pp. 76-84).

Preparations for Soviet geographers' participation in the Stockholm congress began at the end of the summer of 1959, when the second congress circular, establishing the sections, the rules for participation and the deadlines for submission of abstracts and papers, was received in the USSR. The Soviet National Committee's first step was to select the papers of Soviet geographers. This was done partly on the basis of applications received at the time from various geographic institutions and individuals. In addition the National Committee asked the directors of major geographic institutions of the USSR and several leading geographers working in various agencies (Main Administration of the Hydrometeorological Service, Main Administration of Geodesy and Cartography, the Ministry of Geology and Resource Conservation and others) to prepare papers for certain congress sections. The committee sent out more than 115 such suggestions, most of which were accepted. After the receipt of abstracts, the committee organized a scientific review, on the basis of which topics were approved for submission to Stockholm, returned to authors for changes or, in some cases, rejected. The main criteria in the selection of papers were their topical appropriateness for the congress, originality and the high scientific value of the material. Some papers were approved because they might be of great interest to the world geographic community in informing it about the progress of the geographic sciences in the USSR. Few papers were entirely rejected. Nearly in all cases the rejection was due to the regional character of the topic, outside of the framework of the Stockholm congress.

As a result of this work abstracts of 98 Soviet papers were sent to the Organizing Committee of the congress in Stockholm at the end of 1959 for inclusion in the collection of abstracts to be published for the opening of the congress. Some abstracts were submitted after the deadline, largely through the fault of some authors, who did not keep to the deadline of preparing abstracts or to their prescribed length and form. It was largely because authors did not keep to the rigid deadlines set in Stockholm that the Soviet National Committee could not submit to the congress a number of papers that accorded in other respects with the requirements of the Organizing Committee and the Soviet National Committee. All 98 papers whose abstracts were received in Stockholm are regarded as accepted. Most of the full papers were sent to Sweden by March, although in this case also some late submissions could not be avoided.

Soviet papers have been submitted to all nine sections and to several

commissions. They are distributed as follows by sections: Polar and subpolar geography -- 10; geographical cartography and photogeography -- 10; climatology, hydrography, oceanography and glaciology -- 24; geomorphology -- 19; biogeography -- 10; human geography -- 3; economic geography -- 7; methodology and bibliography -- 6; applied geography -- 6. Two papers were submitted to the Commission on Periglacial Morphology and one to the Commission on Karst Phenomena. In addition Soviet geographers will take part in the work of the Commission on National Atlases and in the reports of several other commissions of which they are members.

The subject matter of the papers reflects the principal Soviet achievements in the geographic sciences in recent years and at the same time meets the desire of the congress organizers that the geographic problems of "polar countries" be emphasized. The number of authors, including co-authors, exceeds somewhat the number of papers. They are distributed as follows by institutions: (1) Institutions of the Academy of Sciences USSR and its branches and the academies of sciences of the union republics -- 62 persons; (2) Institutions of the Ministry of Higher and Middle Specialized Education USSR -- 24; (3) Institutions of other agencies -- 16.

The Soviet National Committee made preparations for the organization of Soviet sections at the congress exhibits. Soviet displays at the main cartographic exhibit are expected to include, in full or in individual sheets, all special-purpose maps published since 1956. In addition maps will be shown at the exhibit of the Commission on a World Population Map and new Soviet atlases will be displayed at the exhibit of the Commission on National Atlases. Applications for space have been sent to Sweden and display materials are being prepared according to plans approved by the National Committee.

The Soviet National Committee was also concerned with the preparation of several geographic works whose publication is connected with the congress. The principal publication is the volume Sovetskaya Geografiya, to be published by the Geographical Publishing House in time for the congress. That volume and other publications being prepared were already described in the above-mentioned report to the congress of the Geographical Society of the USSR.

On the initiative of the National Committee, a large group of Soviet geographers is expected to attend the congress. In addition to the official delegation of the USSR, to include nine persons, we are sending to Stockholm as part of so-called scientific tourism a group consisting of staff members of academic institutions, professors and instructors of universities and institutes, employes of the Hydrometeorological Service and so forth. The number of available places should in any case assure the personal participation at the congress of those authors who wish to go to Sweden.

The National Committee has continued its close contacts with the

officers of the IGU, both through correspondence and through personal meetings. During the Humboldt anniversary festivities in East Germany in May 1959, members of the National Committee (K. A. Salishchev and M. B. Gornung) met Prof. Hans Ahlmann, IGU president, and Chauncy D. Harris, IGU vice president. In November 1959, K. A. Salishchev, deputy chairman of the National Committee, visited the president of the IGU in Sweden and met with the organizers of the congress and of its exhibits. In January and February 1960, I. P. Gerasimov, chairman of the National Committee, had several talks on IGU and committee matters with Professor Harris, who was then visiting the Soviet Union.

The Organizing Committee of the congress proposed that Soviet geographers assume the chairmanships of some congress sections. Academician I. P. Gerasimov was appointed chairman of Section I. Academician A. A. Grigor'yev was forced to decline, because of health reasons, the offer of a co-chairmanship in the Section on Methodology and Bibliography. Upon recommendation of the National Committee, the Organizing Committee assigned that post to S. V. Kalesnik, corresponding member of the Academy of Sciences USSR. In recognition of the achievements of Soviet geography and its prominent role in world science, a Soviet geographer was nominated as candidate for membership in the new Executive Committee of the IGU, to be elected in Stockholm. The present IGU Executive Committee nominated Academician I. P. Gerasimov to the post of IGU vice president.

In addition to preparations for the congress, the National Committee was also busy preparing the active participation of Soviet representatives in the work of the General Assembly of the IGU. Under the Statutes there are several aspects in the work of the IGU that do not promote sufficiently active international scientific collaboration of geographers. Quite unsatisfactory, for example, is the work of several IGU commissions, whose work is virtually uncontrolled and depends only on how energetic or interested the chairman is in the work of the commission.

The National Committee and several Soviet geographers have long had a desire to improve some aspects of the work of the IGU. In putting that desire in the form of concrete proposals to be submitted to the next General Assembly, the National Committee discussed the draft of those proposals during 1959 with Soviet geographers, with representatives of other scientific unions, with IGU officers, with representatives of other national committees and with individual foreign scientists. Many of these questions were discussed during the above-mentioned meetings with the president of the IGU and members of the Executive Committee; with Arthur L. Burt, a representative of the United States National Committee, who visited Moscow at the end of 1959; and with prominent scientists of France, Belgium and Sweden during visits to those countries in 1959 by Academician I. P. Gerasimov and Professor K. A. Salishchev. The Soviet National Committee informed the national committees of several people's democracies (Poland, East Germany, Hungary and others) of the substance of its main

organizational proposals. These questions were also discussed with the chairmen of the national committees of some of these countries (Prof. Stanislaw Leszczycki of Poland, Prof. Sandor Rado of Hungary and Prof. Johannes F. Gellert) when they visited the USSR in 1959 or attended the congress of the Geographical Society of the USSR early in 1960.

At the end of 1959 the Soviet National Committee approved the final draft of these proposals and sent them to the IGU Executive Committee. The principal point in the Soviet proposals referred to the make-up of the IGU commissions and their work procedure. Regarding the work of the commissions as a major form of activity of the IGU between congresses, the Soviet National Committee proposed amendments to the IGU Statutes that would promote the effectiveness and activity of the commissions. Under the present wording of the Statutes, there is no control over the work of the commissions or over their formation and the form of their work. The number of commissions, including some that are hardly effective and lack clearly defined objectives or are concerned with excessively narrow problems, is growing without adequately helping to solve either the problems placed before the commissions or major current geographic problems requiring international collaboration of geographers.

The Soviet National Committee proposes to reword the chapter of the Statutes dealing with the commissions along the following lines:

To define in the General Assembly of the IGU or in the Executive Committee the basic objectives and a brief working program of each commission as well as the expected results;

To place moral responsibility for the successful work of a commission on its chairman and on the National Committee of the country in which the chairman works, i.e., to appoint to commission chairmanships those geographers who, in addition to their own high scientific qualifications, can count on the scientific and organizational support of the institutions of their countries;

To consider it essential for each commission to convene one or two plenary meetings between congresses with as wide a participation as possible by persons specializing in the problem studied by the commission;

To decide to extend the term of a commission and its financial support by the IGU only upon presentation of a report on the work program previously approved by the IGU and presentation of a work program for the new term;

To consider it essential that the membership of commissions be planned ahead of time through consultations with the national committees of those countries whose geographers are being nominated to commissions.

The Soviet National Committee also made specific suggestions on changes in the make-up of the commissions. While supporting the idea of renewing the term of commissions that had justified themselves through successful work, the National Committee also urged the transformation of some commissions and the elimination of others. It also proposed the creation of a new Commission on Economic Regionalization. A similar proposal was made by Polish geographers.

In addition to the question of commissions, the Soviet National Committee proposed amendments to the Statutes with regard to the convening of regional geographic conferences of the IGU. On the basis of the experience of two such conferences (in Uganda in 1955 and in Japan in 1957), the committee proposed to add a section to the IGU Statutes granting the right to one or more national committees between congresses to convene regional conferences under the chairmanship of the president or a vice president of the IGU. Such conferences, open to geographers of all countries, would enable large groups of geographers from countries of the given geographic region to gather for discussion of regional problems that cannot be treated satisfactorily at world congresses.

The IGU Executive Committee reviewed the Soviet proposals at the beginning of 1960. The proposals requiring changes in the IGU Statutes will be passed on to a special Statutes Review Committee to be elected at Stockholm to prepare a draft of the reviewed statutes for the 20th congress. The proposals affecting the make-up of the commissions will be discussed in the General Assembly. Both on these and other Soviet proposals discussion will be possible in the General Assembly, whose agenda has already been determined and basically takes account of the wishes of the Soviet Union and of other countries.

In the course of 1959 the Soviet National Committee continued to assist Soviet geographers who were members of IGU commissions. The Commission on National Atlases under the chairmanship of K. A. Salishchev continued its successful work. A conference held by the commission in Moscow in 1958 produced favorable reaction abroad, including reports in the press, and promoted a high level of activity of the commission. At the end of 1959 the main part of the scientific report of the commission was sent to the Publishing House of the Academy of Sciences USSR in the form of a monograph (K. A. Salishchev, editor) on the history of national atlases, their aims and compilation methods. Other members of the commission are also preparing reports for the congress. At the end of 1959 the commission chairman visited Poland, Sweden, Belgium and France to consult with commission members on the general report of the commission and the organization of the commission's exhibit at the congress.

K. K. Markov took active part in the work of the Commission on Periglacial Morphology and attended a plenary meeting of the commission in Morocco in October 1959. He is supervising the preparation of a collection of Soviet papers on the subject matter of the commission and is editing the Asian and Antarctic sections of the world map of periglacial phenomena, which is a major part of the commission's report.

As a result of his requests to the officers of the Commissions on Medical Geography and the Arid Zone, the Soviet National Committee achieved certain changes in the work of these commissions and the establishment of direct contact with Soviet members elected to these commissions. No changes took place in other commissions. At the beginning of 1960

A. M. Ryabchikov was elected corresponding member of the Commission on the Humid Tropics and apparently will be able to take part in the work of that commission in Stockholm.

It was noted above that the Soviet National Committee has not only maintained permanent contacts with the IGU officers, but strengthened ties with the national committees of other countries. In addition to exchanges of information with the national committees of people's democracies that are already members of the IGU (Poland, Hungary, Czechoslovakia) or expect to be admitted (Bulgaria, Rumania), the Soviet National Committee established direct contact with the United States National Committee in 1959. On the latter's initiative, Dr. Arthur L. Burt, committee member, arrived in Moscow at the end of 1959. He acquainted the officers of the Soviet committee with the membership of the United States committee and discussed ways of developing contacts between geographers of the United States and the USSR, particularly during the Stockholm congress; exchanges of information on preparations of the two countries for the Stockholm congress, and so forth. At the beginning of 1960, the Soviet National Committee sent to the United States a complete list of all the Soviet papers submitted to the congress to facilitate their discussion by the American colleagues.

A major step forward in the development of scientific contacts with United States geographers was the signing in November 1959 of the Soviet-United States agreement on exchanges in science, technology, education and culture, which envisaged an exchange of delegations of geographers in 1960-61 of four to six persons each for a period of three to four weeks. Correspondence on that question ended with a meeting at the beginning of 1960 between Academician I. P. Gerasimov and Prof. Chauncy D. Harris, acting for the Academy of Sciences USSR and the Association of American Geographers, to arrange the details of the exchange program. The program was submitted for review to both sides.

Among other actions of the Soviet National Committee not related directly to the IGU, we should mention the permanent contact with the International Council for the Study of Afro-Asian Geography at Aligarh (India). The work of that organization is slow in developing so far. It is preparing to publish No. 2 of its Bulletin, for which the Soviet National Committee supplied some informational and bibliographic materials in 1959. Plans are being made for a second International Geography Seminar of African and Asian countries, apparently in one of the African states.

The Soviet National Committee also took active part in 1959 in organizing foreign trips of some Soviet geographers (to the International Conference on Economic Regionalization in Poland, the Humboldt anniversary festivities in East Germany, participation of Soviet geographers in meetings of IGU commissions, and so forth). As in previous years, the committee replied to various request of Soviet and foreign geographers and institutions. The main task of the committee in 1960 will be to complete preparations for the

congress and the General Assembly of the IGU, to take active part in these two important international geographic events and to organize a detailed scientific report on them for the broad circles of Soviet geographers.

REPORT ON THE 19TH INTERNATIONAL GEOGRAPHICAL CONGRESS AND THE 10TH GENERAL ASSEMBLY OF THE INTERNATIONAL GEOGRAPHICAL UNION AND THE PARTICIPATION OF SOVIET GEOGRAPHERS

Report by the National Committee of Soviet Geographers

(From Izvestiya Akademii Nauk SSSR, seriya geograficheskaya, 1960, No. 6, Pages 3-9)

The 19th International Geographical Congress, organized by the Scandinavian countries (Sweden, Norway, Denmark, Finland and Iceland) took place in Stockholm, August 6-13, 1960, concurrently with the 10th General Assembly of the International Geographical Union. The sessions of the Congress and the Assembly were preceded by excursions and symposia in all five Scandinavian countries. Other excursions and symposia took place after the Stockholm sessions.

The 19th Congress was one of the largest geographical congresses both in attendance and in the number of participating countries. As many as 2,000 persons from more than 60 countries attended compared with 44 countries represented at the preceding congress in Brazil in 1956. (The total number of participants at the Stockholm congress was not determined by the end of the sessions because many persons who had previously announced their participation could not come to Stockholm (for example, the entire Turkish delegation), while others arrived late and were not named in the registration lists.) The United States had the largest delegation -- about 400 persons; together with Canada it even outnumbered the organizing countries. Large delegations were also present from Britain, West Germany, France and Italy.

Eight countries of the Socialist camp (Bulgaria, Hungary, East Germany, Mongolia, Poland, Rumania and the USSR), with a total of 140 participants, were represented. The official Soviet delegation consisted of seven members: I. P. Gerasimov, delegation chairman; K. A. Salishchev, deputy chairman; A. N. Baranov, M. I. Budyko, P. K. Zamoriy, S. V. Kalesnik and V. B. Sochava. In addition 56 Soviet geographers from various cities and republics of the Soviet Union were represented at the congress. All Soviet geographers took active part in all scientific and organizational measures of the Congress and the General Assembly.

Before the opening of the Congress the Soviet delegation had taken part in preliminary discussions with the officials of the IGU and had explained in detail the aims and the substance of the Soviet proposals placed before

the Assembly. In addition, at a meeting of the heads of delegations preceding the Assembly, the Soviet delegation once again presented its arguments in favor of several proposals designed to improve the work of the IGU. (These proposals were submitted for inclusion in the Assembly agenda at the end of 1959 and were published in summary form in No. 3, 1960, of the Izvestiya Akademii Nauk SSSR, seriya geograficheskaya --See Pages 33-40 of this issue of Soviet Geography.) In addition the Soviet delegation presented to the heads of delegations important proposals regarding the procedure of the forthcoming Assembly (see below). Subsequently the Soviet delegation took active part in the Assembly and essentially set the tone of several important discussions.

The specific activity of the Soviet delegation at the Assembly was as follows: After the report of the secretary general of the IGU Executive Committee the Soviet delegation took the floor at the beginning of the first session of the Assembly to protest the illegal presence in the IGU of a Chiang Kai-shekist in the guise of representative of China and drew the serious attention of the IGU to non-implementation of a resolution adopted at the preceding congress calling on the Union's officers to take measures to insure the participation of geographers of the Chinese People's Republic in the Congress. In this connection the head of the Soviet delegation told the Assembly: "The absence of geographers of that great country (the Chinese People's Republic) at the present Congress deprives all of us anew of valuable scientific information and weakens the international association of geographers."

In connection with the election of new IGU officers the head of the Soviet delegation called the Assembly's attention to the fact that the election of a new president of the IGU from among West German geographers may be fraught with serious and unpleasant consequences for the IGU. In the course of this speech the head of the Soviet delegation read the statement of the National Committee of Soviet Geographers, submitted to the IGU Executive Committee, which said in part: "The National Committee of Soviet Geographers considers as untimely the election of a West German as president of the IGU because the activity of the West German delegation at the General Assembly in Rio de Janeiro and the revanchist trend of the activity of many geographic institutions and geographers of West Germany (for example, the publication of maps and atlases showing boundaries that are not in accord with international agreements) show that the election of a West German to the presidency of the IGU will hamper the Union's efforts to rally the international forces of geographers. We propose therefore as an exception to Article III of the Statutes to extend for another term the presidency of Prof. Hans Ahlmann as recognition of his outstanding services as IGU president in giving the IGU a genuinely international character and in strengthening international ties of geographers." The head of the Soviet delegation told the Assembly that in view of this statement the Soviet delegation, though recognizing the personal scientific merits of the candidate of the Executive Committee (Prof. Carl Troll), would abstain in the election of the new IGU president.

As a result of a secret vote, the following Executive Committee was elected for the 1960-64 term: Professor Troll, president; Hassan Awad (Morocco), Dr. Ahlmann(Sweden), Chauncy D. Harris (United States), I. P. Gerasimov (USSR), Kenneth B. Cumberland (New Zealand), Pierre Monbeig (France) and Fumio Tada (Japan), vice presidents. Hans Boesch (Switzerland) was re-elected the Union's general secretary.

A major discussion developed in the General Assembly in connection with the fact that the so-called International Cartographic Association, established in 1959 by a group of Western countries (mainly NATO members), wished to join the International Geographical Union with special conditions, keeping full autonomy in its activities, particularly in the elections of officers and admission of new members. The Union's Executive Committee proposed in this connection to set up a special Commission on Cartography under the IGU for the 1960-64 term (i.e., until the next General Assembly and Congress), such a commission "being formed and guided by the International Cartographic Association," which would serve the "interests of both organizations" (i.e., the IGU and the ICA).

The Soviet delegation strongly protested against measures that would divide the forces of cartographers, weaken the IGU and undermine its authority. Prof. K. A. Salishchev pointed out the separatist character of the International Cartographic Association and insisted that the association, upon being admitted to membership in the IGU, be automatically open to all countries that are members of the IGU. M. B. Gornung called the attention of the Assembly to the unacceptability of the creation of the commission, as proposed by the Executive Committee, from the point of view of the present IGU Statutes. The Soviet declarations were supported by Prof. Sandor Rado of Hungary, who demonstrated convincingly that the International Cartographic Association consisted mainly of military cartographers of the NATO countries and of representatives of large commercial mapmakers of the United States, Sweden and other countries. In the course of the discussion the Executive Committee was forced to exclude from its proposal on the creation of a special Commission on Cartography the statement that the commission would be formed and guided by the International Cartographic Association. The Soviet delegation rejected a proposal that the USSR join the commission. Prof. K. A. Salishchev explained that in view of the existence in the IGU of successful cartographic commissions the creation of a new commission, without clearly stated aims and without ties to the other cartographic commissions of the IGU, would merely accentuate the present general shortcoming in the work of the IGU -- the lack of cohesion in the work of the individual commissions.

A lively discussion in which Soviet geographers took a very active part also arose in connection with the appointment of IGU commissions for the next four-year period. At the center of the discussion were Soviet proposals regarding improvement of the character of the work of the permanent commissions and changes in commissions designed to eliminate inactive

and outdated commissions. The General Assembly adopted a Soviet proposal to convert the Commission on Coastal Sedimentation into a broader Commission on Coastal Morphology. The Assembly also agreed that the proposals of the National Committee of Soviet Geographers regarding the character of work of the two geomorphology commissions (on Erosion Surfaces around the Atlantic and on Evolution of Slopes) correspond to the current tasks of science and instructed the two commission chairmen to prepare by the time of the next congress a complete transfer to the study of the new problems (principles and methods of geomorphic mapping, and modeling of geomorphic processes) proposed by the Soviet geographers. Both commission chairmen agreed to the proposals, and the Soviet proposals were thus essentially adopted. A new commission on economic regionalization, proposed by the Polish and Soviet geographers, was appointed. As a result of a secret vote all existing 15 commissions were continued for the next four years, so that with the two new commissions there will be 17 permanent commissions under the IGU. The seventeen commissions, with their chairmen, are as follows: Bibliography of Ancient Maps (Roberto Almagià, Italy); Karst Phenomena (Herbert Lehmann, West Germany); Evolution of Slopes (Pierre Birot, France); Medical Geography (Jacques M. May, United States); Library Classification of Geographical Books and Maps (André Libault, France); Arid Zone (Peveril Meigs, United States); Periglacial Morphology (Jan Dylik, Poland); National Atlases (K. A. Salishchev, USSR); Erosion Surfaces Around the Atlantic(Francis Ruellan, France); Coastal Morphology (Axel Schou, Denmark); World Land Use Survey (L. Dudley Stamp, Britain); Teaching of Geography in Schools (Benoit Brouillette, Canada); Applied Geomorphology (Jean Tricart, France); Humid Tropics (George H. T. Kimble, United States); World Population Map (William William-Olsson, Sweden); Economic Regionalization (Stanislaw Leszczycki, Poland); Cartography (Eduard Imhof,Switzerland).

The agenda of the 10th Assembly included admission of new members of the IGU. In the preliminary meeting of the heads of delegations the Soviet delegation had proposed that the new members be elected at the beginning of the Congress, rather than at the end, so that the new members could participate in the Assembly and the Congress on the same basis as old members. The elections took place at an extraordinary session on the second day of the Congress and resulted in the admission of 11 new full members and two associate members. The new full members included three additional Socialist countries: East Germany, Bulgaria and Rumania, as well as Australia, Guinea, Iraq, Iran, Malaya, South Africa, Tunisia and South Korea. The total membership of the IGU in 1960 thus reached 53 (including Taiwan) and the number of associate members, after the admission of Hong Kong and Singapore, 7.

The full list of countries members of the International Geographical Union is (in Russian alphabetical order): Australia, Austria, Argentina, Belgium, Bulgaria, Brazil, Hungary, Britain, Guinea, East Germany, Greece, Netherlands, Denmark, Dominican Republic, Israel, India, Indonesia, Iraq, Iran, Spain, Iceland, Italy, Canada, Colombia, Cuba,

Malaya, Morocco, Mexico, New Zealand, Norway, United Arab Republic, Pakistan, Poland, Portugal, Rumania, USSR, United States, Taiwan, Tunisia, Turkey, Uruguay, Finland, France, West Germany, Czechoslovakia, Chile, Switzerland, Ethiopia, Yugoslavia, South Africa, South Korea, Japan (only 52 countries listed -- Editor, S. G.). The associate members are: Hong Kong, Kenya, Nigeria, Singapore, Sudan, Uganda; in addition French West Africa continues to be listed.

In connection with the submission of several proposals to change the IGU Statutes, including some proposed by the National Committee of Soviet Geographers, the 10th Assembly appointed a Statutes Review Committee consisting of Carl Troll, president, and Roberto Almagià (Italy), S. V. Kalesnik (USSR), L. Dudley Stamp (Britain) and Georges Chabot (France).

The main agenda items at the final session of the 10th General Assembly were: appointments of commission members and fixing of the place of the next Congress and General Assembly. Soviet geographers were admitted to all commissions in which they expressed an interest. In most cases the Soviet geographers were elected as regular commission members (i.e., they became part of the commission leadership, consisting of a chairman and five members); in some commissions, Soviet geographers will participate as corresponding members. Prof. K. A. Salishchev was elected to a second term as chairman of the Commission on National Atlases; Prof. Yu. G. Saushkin, member of the Commission on Economic Regionalization; Prof. K. K. Markov, second term as member of the Commission on Periglacial Morphology; Prof. F. F. Davitaya, second term as member of the Arid Zone Commission; Prof. N. A. Gvozdetskiy, member of the Commission on Karst Phenomena; Prof. G. S. Ganeshin, member of the Commission on Erosion Surfaces; Prof. V. P. Zenkovich will continue to work (as a member) in the Commission on Coastal Morphology. Prof. A. N. Formozov was elected member of the Commission on Medical Geography, in which there are already two corresponding members from the USSR (A. A. Shoshin and Ye. I. Ignat'yev). Other Soviet corresponding members of commissions will be A. M. Ryabchikov (Humid Tropics), A. M. Marinich (Evolution of Slopes) and several other Soviet geographers, whose candidature was proposed by the Soviet delegation for commissions whose corresponding members were not designated at the Stockholm congress and will be named by the commissions themselves (for example, Applied Geomorphology and World Land Use Survey).

At its final session the General Assembly unanimously adopted a proposal of the British geographers to convene the 20th International Geographical Congress and the 11th General Assembly of the IGU in 1964 in Britain. The British delegation was unable to fix a definite site, with London, Oxford and Cambridge being cited as possibilities.

The Soviet delegation thus achieved substantial successes in the 10th General Assembly of the IGU in obtaining the adoption of Soviet proposals designed to improve the work of the Union. Representatives of the USSR

were named to the Union's leadership and to membership in the principal commissions. Statements of the Soviet delegation won the approval of a substantial number of Western geographers despite occasional attacks on the Soviet delegation in a few demagogic speeches designed to represent Soviet declarations as "political interference in the work of an apolitical scientific union."

The scientific work of the Stockholm congress was concentrated mainly in ten sections (polar and subpolar geography, geographical cartography and photogeography, climatology, biogeography, human geography, economic geography, methodology and bibliography, applied geography) and in the sessions of the 15 commissions. Soviet geographers were chairmen of leading sections -- Academician I. P. Gerasimov in polar and subpolar geography and S. V. Kalesnik in methodology and bibliography, while K. A. Salishchev was chairman of the sessions of the Commission on National Atlases.

More than 200 papers were read in sectional sessions and somewhat fewer papers in commission sessions. The organization of the Congress made it possible to have brief discussions after almost every section paper. More than 40 section papers were read by Soviet geographers. The geographers of all the Socialist countries accounted for about 40 per cent of all section papers, thus demonstrating the extraordinary scientific activity of geographers from the Socialist countries. Nearly all of those present from Socialist countries read papers compared with no more than 15 to 20 per cent in most of the large Western delegations.

The Stockholm congress also demonstrated an increase in scientific activity of the American geographers, who presented several dozen papers. United States and Canadian geographers together read about as many papers as the geographers of the Socialist countries, leaving slightly more than 20 per cent to geographers of other countries. The Soviet papers, as well as the papers of geographers of the other Socialist countries, treated broad scientific problems or presented the generalizations of the results of substantial, usually collective, research. It should be noted, however, that there was also an increase in problem papers presented by geographers of capitalist countries, particularly the United States, and that there were fewer papers concerned with minor, particular subjects. In general the make-up and the number of papers were evidence of increased activity among geographers of the bourgeois countries, especially the Americans, in the field of political, commercial and economic geography.

An analysis of the content of the papers presented at the Stockholm congress cannot be given in the present report. The National Committee of Soviet Geographers proposes to discuss the scientific results of the Stockholm congress in individual articles of the Soviet participants, as well as in a special volume of proceedings of the congress, including fuller reports of the Soviet delegation, the texts of the Soviet papers, reports on the work of sections and commissions, and other materials.

An important part of the Stockholm congress was cartographic exhibits, including Swedish national maps, an international cartographic exhibition and an exhibit of national atlases, in which Soviet geographers participated actively.

Another feature of geographical congresses, the excursions, which for the Stockholm congress were organized within the Scandinavian countries, were of particular interest to Soviet geographers, enabling them to become acquainted with countries near the Soviet Union. Members of the Soviet delegation took part in the special congress excursions (I.P. Gerasimov going to Iceland, K. A. Salishchev and V. B. Sochava to northern Sweden, S. V. Kalesnik and M. I. Budyko to central Norway). More than 50 Soviet participants returned from Stockholm through northern Norway and Finland to Leningrad. During the Congress Soviet geographers made small excursions through the Stockholm area (the Stockholm archipelago, Stockholm's satellite cities, a karst excursion to Gotland, and so forth).

Delegates and participants from the USSR visited several Swedish scientific institutions, including meteorological and cartographic institutions in Stockholm. Soviet geographers familiarized themselves with Swedish work on forest soils, with the work of Swedish zoogeographers and swamp specialists and with spore-and-pollen-analysis work. Soviet participants had an opportunity to acquaint themselves in detail with geographic education and work in various geographic disciplines at the universities of Stockholm and Uppsala.

Also to be mentioned is an important public and scientific action of the Soviet delegation during the Stockholm congress. On August 12 the Soviet delegation presented to Prof. Hans Ahlmann of Sweden, president of the Congress and president of the IGU, the Great Gold Medal of the Geographical Society of the USSR, awarded to him earlier in the year. The presentation took place at a reception at the Soviet Embassy, to which more than a hundred foreign geographers had been invited (the heads of nearly all the national delegations, officers of the Organizing Committee of the Congress, officers of the IGU, and the most important geographers of various countries). The reception was attended by all Soviet geographers who were then in Stockholm, as well as by diplomats and journalists. After a brief greeting by Ambassador F. T. Gusev of the Soviet Union, the head of the Soviet delegation, Academician I. P. Gerasimov, made a speech and presented the gold medal and a diploma to Professor Ahlmann. Professor Ahlmann expressed his profound gratitude for the great honor shown him by his Soviet colleagues and spoke of the long-standing ties between the geographers and travelers of Sweden and Russia, and now the Soviet Union. The Swedish press published a special report on the event.

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THE 19TH INTERNATIONAL GEOGRAPHICAL CONGRESS

By S. V. Kalesnik

(Excerpted from Izvestiya Vsesoyuznogo Geograficheskogo Obshchestva, 1950, No.6, Pages 544-45)

The 19th International Geographical Congress took place in Stockholm, August 6-13, 1960, with the participation of about 1,500 geographers from 64 countries. The Soviet Union was represented by 60 persons.

The opening of the congress took place in the great hall of Folkets Hus. Speeches of greetings were made by Prof. Rickard Sandler, chairman of the Swedish National Committee of Geography, and by Prof. Hans Ahlmann, president of the International Geographical Union. Afterwards Prof. William William Olsson gave a talk on "Stockholm: Structure and Development."

The subsequent work of the congress proceeded in sections, of which there were ten.*** Soviet geographers were chairmen of two sections -- I. P. Gerasimov, chairman of the section on polar and subpolar geography, and S. V. Kalesnik, co-chairman of the section on methodology.

About 200 papers were read in all sections, about 20 per cent being contributed by Soviet geographers. Thirty minutes were allotted for each paper and discussion; each paper (with discussion) began and ended strictly on time, making it easy for participants to hear papers in different sections.

The papers of Soviet geographers, which invariably attracted much attention, covered broad scientific problems and the results of major individual or collective studies. They included: the results of Soviet studies in the Antarctic (K. K. Markov), the climatic factors of geographic zonality (M. I. Budyko and A. A. Grigor'yev), the development of Soviet hypsometric and geomorphic maps (I. P. Zarutskaya), the results of studies of the geomorphology of the bottom of the Southern Ocean (A. V. Zhivago), the new economic regions of Eastern Siberia (V. A. Krotov), the laws of distribution of precipitation related to the population centers in the USSR (V. V. Pokshishevskiy), the physical geography of the Soviet cold pole (I. P. Gerasimov), the classification of the geographic sciences (S. V. Kalesnik), the water and heat balance of the earth's surface (M. I. Budyko), economic geography as a science of the territorial complexes of productive forces (Yu. G. Saushkin), new data on the geography of vegetation of the Soviet Baltic area (V. B. Sochava and A. G. Isachenko).

A characterization of the scientific work of the congress, which was undoubtedly a great event in the life of the international association of geographers, will be offered later in a separate publication to be issued by the National Committee of Soviet Geographers.***

Participants of the congress received a large amount of geographical publications, including the Abstracts of Papers, A Geography of Norden (edited by Axel Sømme), Stockholm: Structure and Development, by William William-Olsson, excursion guidebooks, and so forth.***

THE 19TH INTERNATIONAL GEOGRAPHICAL CONGRESS

By Yu. G. Saushkin

(Excerpted from Geografiya v Shkole, 1960, No. 6, Pages 2 - 6)

The geographers of 65 countries met in Stockholm in the first half of August (August 6-13) to present the results of what had been done in geography in the four years since the last congress in Brazil.

The 19th International Geographical Congress was organized by the northern European countries, Sweden, Norway, Denmark, Finland and Iceland, known as Norden. The Organizing Committee of the congress was headed by the outstanding Swedish geographer, Hans W:son Ahlmann, president of the International Geographical Union and professor at Stockholm University. Professor Ahlmann is well-known through his studies on the Arctic and Antarctic, his glaciologic and paleoclimatic research, and studies on the geography of Norway and other countries. He has visited the Soviet Union several times, worked together with Soviet geographers on the study of the Arctic, and has done much to establish scientific ties between geographers of the USSR and of other countries.***

The large building Folkets Hus was hospitably made available in Stockholm to the Geographical Congress for its meetings. The Swedish capital is a large industrial, transportation, commercial and cultural-political center of Sweden. Its population (together with satellite towns) exceeds one million people (1,060,000 in 1955). Out of a working population of 480,000, more than one-third is employed in industry (35.4 per cent), about one-third in trade (30.3 per cent), and one-tenth (10.2 per cent) in transportation. Women make up about 40 per cent of the working population. Stockholm's characteristic industries are machine building (including electrical goods), employing 66,000 people; printing (21,000), food processing (15,500), textiles and garments (12,000). The printing industry turns out publications of high quality. Among the printing plants is a large map-printing plant, equipped with the most modern machinery.

Stockholm developed at the point of contact between the large lake Malaren and fjords extending to the coastal zone of the numerous skerries of the Baltic Sea. Stockholm includes a huge water area. In 1956 its port was visited by 43,000 vessels with a total of more than 10 million tons, including 6,700 foreign-flag ships.

The water together with the green of parks, squares and gardens makes Stockholm a beautiful city. It is well "ventilated" from the sea, and even in the center of the city the air is free of smoke and soot. Specially noteworthy is the wooded park called Skansen, one of the popular recreation places of Stockholm's population. In summer many inhabitants of the capital move to cottages in the archipelago. Stockholm has just as many motorboats and sailboats as automobiles, used by the inhabitants on holidays and in vacations.

In recent years large satellite towns, such as Vällingby (70,000 inhabitants), have grown up around Stockholm with a rather distinctive planning lay-out and architecture. These suburbs are linked with the center of Stockholm by subway and other means of transportation. The visitor is impressed by the way trees are carefully preserved and the dissected relief is skillfully utilized in the construction of these satellite towns, and by the way they are blended with the urban landscape of rocks, lakes and fjords.

The center of the city is also changing. Of interest is a three-level transportation hub built in Stockholm's narrow isthmus connecting the center of the city with its southern part. Old buildings are being razed in the city center to be replaced by skyscrapers of steel and glass that do not harmonize especially well with the general appearance of the fine green of the Swedish capital.***

The largest delegations at the 19th International Geographical Congress were from the United States, the USSR and, of course, Sweden. It was originally assumed that the papers at the congress would be devoted mainly to problems of the geography of the northern countries and the Atlantic; actually such a "specialization" did not take place. Many of the papers treated topics far removed from the northern countries or the Atlantic. In general the result was a rather diversified picture, and unity of subject matter was observed only in the meetings of the IGU commissions.***

Alone the list of sections and commissions at the congress shows how diversified modern geography has become. It is sometimes said in the literature that a "unitary" geography prevails abroad, while geographic knowledge is differentiated in the USSR. Actually the geographers of foreign capitalist countries are working with a sharply differentiated system of geographic sciences. For example, physical geography as an integral science has dropped out entirely from the congress agenda. Papers dealing with physical geography as a whole were assigned to the section of Methodology and Bibliography.

According to the published congress program, a total of 250 papers was distributed among the sections. Most of the papers were economic-geographic in content (in the sections on human geography, economic geography, applied geography and, in part, in the section on methodology and bibliography), a total of 104. This shows that economic geography continues to be the "queen" of world geography, which is of course no accident since economic geography is related directly and more closely than other geographic disciplines

with life and with practical work. In second place in number of papers was the section on geomorphology (35) and in third place the section on climatology and hydrography (29).

The most indefinite in subject matter were probably the sections on methodology and bibliography and on human geography. The section on human geography contained papers on the geography of religion, historical geography, ethnography, population migrations, cities, rural settlements and the economic development of areas. As a result of the work of that section, it seems to me that the term "human geography" has been completely discredited.

The section on economic geography was far more cohesive in the subject matter of its papers. Papers on the geographical distribtuion of branches of the economy of various countries, on economic regionalization and on regional planning predominated. Together with papers of considerable theoretical and practical significance, there were quite a few descriptive papers during which the room usually emptied rapidly, only to be filled again as soon as papers on important problems of economic geography were presented. Economic geography turned out to be somewhat crowded within the section of that name and several interesting papers with an economic-geographic content were read in the section on applied geography, notably papers on the application of mathematical methods to studies of regional complexes (Walter Isard and other American geographers).

A leading role at the congress was played by Soviet and American geographers, who read most of the papers in sections and commissions -- 144 according to the published program. Americans read 78 papers and Soviet geographers, who were three times fewer than the Americans, presented 68. To be noted is the quantitative and qualitative contribution made by geographers of the people's democracies: Poland, Rumania, Hungary, Czechoslovakia and East Germany; the Poles, for example, presented 21 papers.

As a general rule Soviet papers attracted many listeners, provoked questions and discussion and were warmly received by the audiences. They included, for example, K. K Markov's "Results of geographic research in the Antarctic"; G. B. Udintsev's and A. V. Zhivago's "Geomorphology of sea beds and modern problems of marine geomorphology"; V. A. Krotov's "New economic regions of East Siberia"; N. A. Gvozdetskiy's "Karst phenomena and karst study in the USSR"; S. V. Kirikov's "Past (16th-19th centuries) and recent distribution of game animals in the USSR"; S. V. Kalesnik's "Classification of the geographic sciences"; S. B. Slavin's "Industrial development of the Far North of the USSR"; M. I. Budyko's "Thermal and water regimes of the earth's surface"; T. V. Zvonkova's "Practical applications of geomorphology in the USSR"; M. A. Glazovskaya's "Geochemistry of Southern Urals landscapes and the prospecting for copper ore"; and K. A. Salishchev's report on the results of the work of the Commission on National Atlases, which he heads.

Problems of the methodology of geography, its ways of future development as well as problems in university and school geography appeared to be relegated to second place at the congress.

Among the theoretical papers, besides the one by S. V. Kalesnik, were the talk by Richard Hartshorne, the American theoretician; a brilliant paper by Josip Roglic of Yugoslavia on "Basic problems in geography," and a paper by Hans Carol of Switzerland on "Geography in the future."

The Commission on the Teaching of Geography in Schools met four times. The papers had predominantly a strictly practical approach. The titles of two days' sessions were: "The development of the teaching of regional geography in British schools"; "Usefulness of the method of studying relations between phenomena in the teaching of regional geography"; "Scope and sequence of geographic education in the modern school"; "Results of testing the geographical knowledge of 1,000 students entering college"; "Geographic concepts of the space age"; "Time-space devices and theories for the geographer-educator"; "Research in the design of geographic teaching materials"; "Geographical school excursions in New Zealand"; "Color slides as a help in the teaching of geography"; "Exemplary working in geographical lessons at secondary schools"; "A contribution to the scientific classification of apparel in the teaching of geography in schools"; "International collaboration in the preparation of elementary textbooks in school geography;" "Local maps and atlases in the teaching of regional geography."

Unfortunately the National Committee of Soviet Geographers had not thought of submitting a paper by a Soviet geographer-educator to the Commission on the Teaching of Geography in Schools. Considering the large number of Soviet geographers who made a major contribution to the scientific success of the Stockholm congress, a noticeable gap was the complete absence of Soviet papers on the teaching of geography in schools. Soviet geographers and educators would have had much to talk about -- the reform of geography teaching tending to bring it closer to practical applications, the home-area work of geography teachers and many other subjects.

Just a year ago the magazine Geografiya v shkole (1959, No. 6) wrote in its editorial article "Geography teachers and geographic science on the eve of the First Russian Teachers Congress" that geographers still lack close ties with schools and with the teaching profession. The paper on "Reform of the Public-Education System in the USSR and the Tasks of School Geography," presented by N. N. Baranskiy, A. V. Darinskiy and A. I. Solov'yev at the Third Congress of the Geographical Society USSR (Kiev, 1960), pointed out that the editorial furnished an adequate basis for discussing such problems as ties between teachers and the scientific geographic community, and so forth. Actually those ties have not improved and, as a result, among the nearly 70 Soviet delegates at the 19th International Geographical Congress there was neither a geographer-educator nor a paper on the teaching of geography in Soviet schools.

One more comment. The American geographers, for example, gave papers not only on United States topics, but also on India, Africa and in two instances on the economic geography of the USSR (Theodore Shabad on the distribution of the synthetic-rubber industry and Allan L. Rodgers on the distribution of the coke industry), while Soviet geographers limited themselves to material on the USSR (except for the Antarctic and the oceans). There is no need to prove that Soviet geographers, who work a great deal on the geography of other countries, could have presented fine papers at the congress on the economic geography of the United States or the geography of the Chinese People's Republic or the geography of the Scandinavian countries. It is regrettable that the National Committee of Soviet Geographers failed to organize papers along those lines. ***

Soviet geographers brought some fine geographic publications to the congress: K. A. Salishchev's "National geographic atlases" (in French) and the volume Metody geograficheskikh issledovaniy (Geographic Research Methods), written by members of the Geography Faculty of Moscow University.

During the congress, a large map exhibit was open in a neighboring building. It contained especially many American maps. The Americans had even brought along a machine that was stamping out a relief map showing graphically the topography of the area covered by one of the sheets of the map of the United States.****

The geographical congress in Stockholm demonstrated that among the geographers of many countries there exists a rather close collaboration that could be strengthened even further. Geographers working on similar problems met in the corridors of the congress for friendly discussions. Great mutual interest in each other's work was evidenced by Soviet, American, Canadian and Swedish geographers as well as the geographers of other countries.

After the congress two large groups of Soviet geographers took part in an excursion to northern Sweden (Lulea-Kiruna), northern Norway, northern Finland and the central lake plateau of Finland (Tampere), with a concluding visit to Helsinki. The excurison was instructive in many respects and acquainted Soviet geographers with many areas of the Scandinavian countries situated north of the Arctic Circle. It is to be regretted once again that no Soviet geography teachers and geographer-educators took part in the excursion although geography teachers of other countries took part in similar excursions.

The next International Geographical Congress is expected to meet in London in 1964. Although it is still four years away, we should now gradually start thoroughly preparing for the London congress to present Soviet geographic science in an even better light than at Stockholm, and particularly to display at the congress the best achievements in the teaching of geography in Soviet schools.

THE TIMBER INDUSTRY OF NORTHERN EUROPEAN RUSSIA

By V. L. Gorovoy

(From Geografiya v shkole, 1960, No. 6, Pages 7-15)

(Abstract: A description of the timber reserves, logging operations and the lumber and paper mills of Northern European Russia.)

The huge territory of Northern European Russia (1.2 million square kilometers) had a population of only 3.4 millions in 1959. This is one of the principal causes of the nodal distribution of its economy.

Despite the difficulties associated with the as yet inadequate settlement of the area, Northern European Russia has assumed an important place among the country's economic regions in Soviet times. In 1958 it yielded about 13 per cent of the nation's timber, 7 per cent of the sawn wood, 4 per cent of the coal, 3 per cent of the fish and 4 per cent of the flax fiber. The region is the nation's leading timber exporter.

The growth of the regional economy has been aided by the diversity of its natural resources. Large mineral deposits have been found there in Soviet times. The Pechora coal basin, extending through the northeast of the Komi ASSR to the sea is in terms of its total geological reserves (344 billion tons) the largest in the European part of the USSR. Its value lies in its large reserves of coking coals. Oil and gas are found near the Timan Ridge and in the southeast of the Komi ASSR. Bauxite was recently discovered in the watershed between the Northern Dvina and the Onega. The reserves of building materials are inexhaustible: granites in the Onega basin, limestone and gypsum in the Northern Dvina basin, marl in the Vychegda basin, basalt in the Timan Ridge, as well as clay, sand, gravel and many others. There are large deposits of salts, including rock salt near the mouth of the Vym' in the Vychegda River (Komi ASSR), quartz sands in western Vologda Oblast, oil shale and asphaltite in the Komi ASSR, grindstones in the Pechora basin. There are many salt springs. Arkhangel'sk Oblast alone contains one-fourth of the peat reserves of European Russia. The potential water-power capacity of the Pechora, Vychegda, Onega and other rivers amounts to millions of kilowatts. A great deal of energy can also be generated by tides, which reach a height of 10 meters in Mezen' Bay. But the principal regional resource is timber.

The dark-green tayga extends as far as the eye can see. Here and there the forest is interrupted by meandering streams and by lakes. Swampiness increases toward the north. Forest stands thin out toward the north, as they approach the tundra, and toward the south, where man has cleared large areas for agriculture.

The timber reserves in the State Forest Reserve (5 billion cubic meters)

exceed by 70 per cent the forest reserves of Sweden and Finland together. A high percentage of mature and overage stands makes it possible to harvest more timber than is produced each year by normal growth. The most common woods of the European North -- spruce and Scotch pine -- are noted for their strength and elasticity. However, the northern forests because of the cold climate and the high degree of swampiness are less productive than the thinner forests of adjoining areas. The northern forests contain mainly trees with thin trunks, more suitable for pulping than for sawmilling. The quality of the timber decreases from southwest to northeast as it approaches the tundra.

The timber industry is the basis of specialization of the economy of the European North. To it are related the other leading branches of the regional economy. The coal industry supplies fuel to the wood-processing enterprises, and in turn receives pit props and building lumber; the machine-building industry supplies the timber industry with equipment, transportation and listing devices (tugboats, hoists), receiving in turn sawn wood; the timber industry also produces barrels for the fish-processing and butter-making industries.

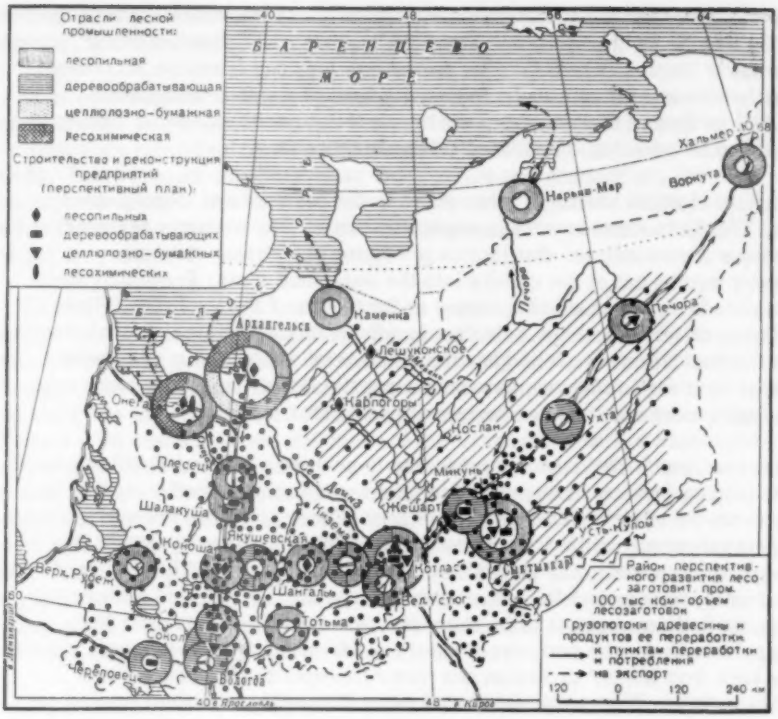
The timber industry of the European North represents a whole complex of interrelated industries, a structure for which the logging industry is the foundation. During the Soviet period the logging industry has been transformed beyond recognition. Alone during the period 1940-58 the logging of merchantable timber increased by almost 70 per cent, as shown in Table 1.

Table 1. Logging in the European North
(in million cubic meters)

	1940	1958	% change
All wood	31.6	41.3	+30.7
Merchantable timber	18.9	31.8	+68.3
Firewood	12.7	9.5	-22.1

The peasant's axe, saw and horse has been replaced by a whole system of machines and mechanized equipment ranging from power saws to tractors. The modern lumber center is a large mechanized enterprise employing thousands of loggers. It is usually situated in a large rural settlement (rayon seat) or at the terminal of a logging road on a main railroad line or river. The lumber center directs logging operations at camps scattered through the forest, supplying them with materials and electric power, repairing their equipment and providing schools for the children of loggers who live in camps that lack their own schools.

Loggers' camps are often scattered deep in the forest. Daily they go to work at logging sites. Trees are felled with power saws, then hauled by tractors to the upper landing situated at the head of the lumber road. There



The Timber Industry of Northern European Russia

(Legends:) (upper left) (lower right)

Branches of the timber industry:

- sawmilling
- wood processing
- pulp and paper
- wood chemicals

Long-range building and reconstruction plan:

- sawmills
- woodworking plants
- pulp-and-paper mills
- wood-chemical factories

Areas of future development of logging operations

Each dot represents 100,000 cubic meters of logging

Transport flows of logs and wood products

- to processing mills and markets
- export

the trees are topped and the branches trimmed off, and the trunks are bucked into log lengths for transportation along the logging road (by rail or truck) to the lower landing, where they are sorted into logs and crosstles according to destination and are either piled up on the bank of the river along which they will be floated downstream in the spring to log ponds for further sorting and rafting or loaded on a regular-guage main railroad.

Radical changes have also taken place in the geography of logging operations. Thanks to improvements in log transportation and measures designed to achieve a more rational distribution of logging operations, they are gradually moving out of the valleys into the watershed areas. Previously inaccessible areas are now being logged in the basins of the Vychegda, Pinega and Onega rivers. Wasteful, selective logging practiced before the revolution, when the best trees were felled and the others were left standing, has been replaced by clear cutting, which makes it possible to utilize all the wood on the logging sites and to insure high-quality reforestation.

However, much still remains to be done to achieve a rational distribution of the logging industry. Logging is too intensive in some places (for example, several rayons of Vologda Oblast and in some places along the Pechora and Northern railroads), while the forests in the middle and upper Vychegda, the Pinega, and especially the Mezen' and Pechora basins are not being logged sufficiently, only part of the annual growth increment being felled each year. If logging in these areas is to be expanded, transportation lines must first be supplied. Under the seven-year plan, regular-gauge logging railroads are to be built from Mikun' to Koslan and from Arkhangel'sk to Karpogory and Leshukonskoye. These railroads would make it possible to expand logging operations in the basins of the Pinega and Mezen' rivers. Later logging railroads are to be built from the main Pechora line toward the Pechora River.

The workers of the lumber industry face the task of making maximum use of all the wood found on logging sites: not only merchantable lumber but also firewood and the so-called by-products of logging sites, such as tree tops, branches and coniferous needles. For that purpose felled trees are hauled directly to the lower landings of lumber centers, where wood waste is used for the manufacture of rosins, chipboards, fiberboards and other products.

In view of the favorable geographical location of the European North with respect to the main lumber consumers of European Russia and in view of its leading role in supplying the European part of the Soviet Union with lumber, every effort must be made to conserve and renew its forest resources. This will be in many ways facilitated by a broad reclamation program, especially swamp drainage, and the improvement of the species composition of the timber stands. The fact that the logging organizations themselves will be responsible for reforestation according to a recent government order is also a contributing factor. As time goes on, many lumber centers and logging camps will have permanent jurisdiction of forest areas with a permanent network of logging roads in which, as a result of a broad reforestation

program , timber reserves not only will not exhaust themselves but, on the contrary, will be steadily expanded.

Logs reach sawmills mainly by being floated downstream. The mouths of small streams along which logs are floated after the ice has broken up in the spring are closed off by a floating fence of connected logs to form log ponds. There loggers sort the floated logs by size and destination. On the major streams -- the Northern Dvina, Vychegda, Pechora, Mezen' -- and in the mouths of their tributaries there are log ponds where the logs are not only sorted but assembled into rafts.

The log-floating season lasts only a few months; for example, on the Northern Dvina from May to October. Because of its large lumber-floating role, the basin of the Northern Dvina is second only to the Volga basin in the volume of freight transportation. Lumber floated along the Vychegda and along the Little Northern Dvina (the name given to the river between the Sukhona-Yug confluence and the mouth of the Vychegda River) is assembled into rafts at Kotlas, where part is sent to lumber-transfer points for shipment to lumber-deficit regions of the country, part is processed by local enterprises and the rest is sent to Arkhangel'sk in the form of large tug-drawn rafts. Not far from Arkhangel'sk the lumber flow reaches its maximum size (several million cubic meters); there part of the lumber is transferred to the railroad, part is sent to the lumber port of Arkhangel'sk for loading on foreign ships, and the bulk of the lumber is sent to the storage ponds of the wood-processing enterprises of Arkhangel'sk.

Log floating in the Onega basin has its distinctive features: first, its volume is far smaller; second, logs are floated individually downstream to the Onega lumber-industry node because rapids and shallow stretches along the Onega River are not suitable for rafting; third, in view of the connections between rivers and lakes of the Onega basin (resembling in many ways the Karelian river-and-lake system) log running along rivers is often combined with rafting across lakes. The logs arriving at the river mouth on the lake are assembled into strings and drawn by a tug across the lake to the head of another stream, where individual log running is resumed.

Log floating on the Pechora is relatively unimportant because of the lack of development of the logging industry on its banks; most of the lumber is transshipped at the city of Pechora to the Pechora Railroad, and the rest is floated downstream to the sawmill at Nar'yan-Mar.

Log floating is very limited (300,000 to 500,000 cubic meters) in the Mezen' basin; nearly all the lumber is floated to the sawmill at the river's mouth.

The network of logging streams in the southwest of Vologda Oblast belongs to the Volga basin.

At the present time the European North has a large lumber-processing industry. If we regard the logging industry as the foundation of the structure, sawmilling and wood processing make up the first floor. In 1958 the region produced 5.6 million cubic meters of sawn wood, most of which was shipped to other regions of the Soviet Union or exported. The European North accounts for about two-thirds of the Soviet Union's sawn-wood exports.

The output of the sawmilling and wood-processing industry is very diversified: among the items added to the boards, crossties and box shook in the post-war period are prefabricated houses, fiberboards and chipboards, and wood flour; the production of furniture has also been increasing.

Before the revolution the sawmills of the European North worked exclusively for export and were concentrated at the mouths of the large streams on the sea. Even now the largest sawmilling and processing center is Arkhangel'sk. In Soviet times several large lumber-manufacturing plants have been built there, including the 24-carriage No. 16-17 sawmill, which is associated with the Solombala paper and pulp mill. This one sawmill alone produces hundreds of thousands of cubic meters of sawn wood, more than entire oblasts, such as Minsk or Omsk. It works on Scotch pine logs. Throughout the floating season cranes lift logs out of the water and pile them up in storage yards to insure uninterrupted sawmill operations during the winter. Other lifting devices and conveyors transport logs from the river over log slips to the saw carriages for sawing into lumber. Part of the wood waste is used for the manufacturing of box shook and other small items, while the rest is sent to the Solombala mill for pulping. Other important sawmill centers are Onega and Kamenka (at the mouth of the Mezen' River).

During the five-year plans sawmills and wood-processing plants were brought closer to the raw material and to the markets. A whole string of sawmills and processing plants arose along the Northern and Pechora railroads, the largest centers being Kotlas and Sokol. Syktyvkar will also become an important lumber-manufacturing center. This tendency in the development of the sawmilling and wood-processing industry is expected to continue.

In addition to the reconstruction of mills in Arkhangel'sk and other coastal points during the current seven-year plan, large sawmilling and processing and prefabricated-house factories are being built at Cherepovets (Vologda Oblast), Shalakusha and Shangaly (Arkhangel'sk Oblast), Ust'-Kulom and Zheshart (Komi ASSR) and other places.

An important step forward after the revolution was the erection in the European North of the "upper floors" of the lumber-industry structure -- paper-and-pulp milling and wood hydrolysis. Two paper-and-pulp mills and a hydrolysis factory are operating at Arkhangel'sk, a hydrolysis factory at Onega and a paper-and-pulp mill at Sokol. (Peasants in Northern European Russia have long been tapping pine trees whose oleoresin by dry distillation yields turpentine, rosin and other products. Until recently this

industry was in the hands of cooperatives. The main production area is the basin of the Vag River. The tapping industry should be revived by shifting it to areas richer in forest resources.) Much remains to be done to utilize all by-products of the logging industry. Millions of cubic meters of waste are left along logging roads, hauled out of the sawmills or burned wastefully although they could be used to produce pulp, ethyl alcohol, paper and paperboard, fiberboard and plastics, artificial ice and yeast, viscose fiber and turpentine and a host of other products.

Such utilization of nonmerchantable timber can be of great benefit to the economy. One cubic meter of wood waste can yield 150 kg of viscose pulp or 1500 meters of high-grade artificial silk. In the production of ethyl alcohol, used for the manufacture of synthetic rubber, paints and other products, one ton of sawdust replaces 0.6 ton of grain or two tons of potatoes. One cubic meter of chipboard can be made into as much furniture as 2.5 cubic meters of sawn wood. One ton of paperboard, made out of three or four cubic meters of wood waste, replaces 8 to 12 cubic meters of box shook in the making of boxes and is more than three times cheaper. One thousand cubic meters of wood waste yields 80 tons of high-protein yeast cakes, replacing in feed value about 280 tons of oats or 6,400 tons of silage.

Steps are now being taken to develop an integrated wood-processing industry making maximum use of wood. The seven-year plan envisages, in particular, the completion of a large paper and pulp mill on the Vychegda River near Kotlas (at Koryazhma -- Editor, S. G.). The mill will be quite unusual. Although some mills in the United States and Canada may rival it in size, it will have no equal in its range of products (about 20). Its main output, produced mainly from nonmerchantable timber cut in the basin of the Vychegda River, will consist of hundreds of thousands of tons of pulp, including viscose pulp, paper, boxboard and tens of millions of liters of alcohol a year. The capacity to be added to the mill in 1960-63 is expected to exceed the 1940 level of Soviet pulp production.

Work is expected to start shortly on another large paper and pulp mill at Syktyvkar, to be followed by similar mills on the Pechora River. Pulp and paper production and wood hydrolysis is to be expanded at Arkhangel'sk, Onega and Sokol. Alone the Kotlas and Arkhangel'sk mills are expected to produce as much paperboard as the entire Soviet Union produced in 1958 (720,500 tons -- Editor, S. G.).

At the lower landings of lumbering centers and at sawmills and wood-processing plants, wood waste will be utilized for the manufacture of fiberboards, chipboards, and wood chemicals. The European North will thus become a large supplier not only of round wood and lumber products but also of wood chemicals.

THE CONSTRUCTION OF ECONOMIC MODELS OF REGIONAL AND LOCAL TERRITORIAL-PRODUCTION COMPLEXES

By Yu. G. Saushkin

(From Vestnik Moskovskogo Universiteta, seriya geografiya, 1960, No.6, Pages 3-9)

(Abstract: A discussion of the use of economic models for the planning of new industrial enterprises or changing the specialization of existing enterprises within industrial complexes. Despite some differences in N. N. Kolosovskiy's definition of a territorial production complex and Walter Isard's definition of an industrial complex, Isard's method of building economic models is found applicable to Soviet conditions.)

The question of the proper geographical location of new industrial enterprises and the rational specialization of existing plants and factories is one of the most important questions in Communist construction. Unfortunately the theory of industrial location has not yet been sufficiently developed and thus far contributes little to the scientifically justified selection of the location of a specific plant. The large amount of experience in new industrial construction and in the reconstruction of enterprises has not been adequately generalized from an economic-geographic point of view.

V. I. Lenin regarded as the principal criterion of rational industrial location the minimum loss of labor required for passing from one production stage to another, i.e., achievement of the maximum productivity of social labor. That criterion leaves no room for voluntarism in industrial location and makes it possible to use precise economic calculations for the selection of a plant site.

The economic effectiveness of industrial location insuring the maximum productivity of social labor for a given level of production and a given optimum level of technology is the main principle of location of Socialist production. However there is need for a deeper understanding of that principle and for taking account of several additional factors without which the selection of new plant sites would be one-sided.

Above all, industrial location is inseparable from the process of industrial development. Each stage of Socialist (and now Communist) construction of the country as a whole is characterized by its distinctive volumes and relationships of production, its plant sizes and types, its level of technology, and its transportation network and technology. The character of expanding reproduction in the country as a whole substantially affects industrial location, which is one of the principal conditions and results of the process of development of production.

The process of expanding reproduction specifically includes both

expansion of research and intensification of use of the country's natural resources, especially its minerals, water resources, soils, forests and so forth. As shown by the wide experience of the Soviet economy, the discovery of new natural resources conditions to a large extent the location of new important industrial nodes in the country. However, the present state of technology can also render quite effective increased geological exploration in old densely populated industrial areas, where in several cases large new fuel and mineral resources have been uncovered. Thus we find that industry is created in new areas of raw materials, fuel and power resources and, on the other hand, that new resources are brought nearer to historically formed centers of industry. A calculation of comparative economic effectiveness should show in which specific cases one of these two ways is the more rational from a national economic point of view.

In studies devoted to industrial location a great deal has been written on bringing industry closer to sources of raw materials (fuel and energy) and to markets, but these studies have ignored the question of industrial location in areas having a rapidly growing labor force that remains in large part within these areas. Actually the rapid rise of the labor force at the present rate of mechanization of production requires in the case of certain areas the location of new plants that would assure work for the population and satisfy its rapidly growing demand for industrial goods. Here we must calculate the effectiveness of the location of plants that are labor-oriented and in many cases lack an adequate local raw-material base.

Industrial location should take account not only of the economic objectives of the current stage of development of production, but its long-range prospects in the light of future progress in science and technology, the drawing of new natural and labor resources into production, expansion and changes in the structure of consumption, and so forth.

Industrial location in all the republics of the Soviet Union should take account of its economic effectiveness and the aim of insuring a maximum productivity of social labor. Industrial location must, of course, also take account of the national characteristics of the republics, the distinctive character of the growth of consumption in each republic, the need for employing the growing population in industrial enterprises and so forth. The defense needs of the country must also be borne in mind in industrial location.

Productive forces develop and are distributed in space by interacting with each other and forming territorial complexes. Territorial production complexes can have various scales, ranging from large (regional) forms to smaller local forms, such as industrial nodes.

An industrial enterprise is located or changes its specialization within a given complex. The question of locating the enterprise outside of the complex does not arise because a site suitable for the isolated location of the enterprise or suitable from the point of view of the industry of which the enterprise is a part may be entirely unsuitable in terms of the whole territorial complex.

On the other hand, a site that is unsuitable from the point of view of a certain industry may be quite suitable if its location and prospects are assessed within the framework of the territorial production complex.

Only when the enterprise lies within the boundaries and within the system of the productive relationships of the territorial production complex, can it be regarded as within its real economic-geographic environment, and only then can the economic effectiveness of the construction of the enterprise be calculated.

Every new industrial plant built in a certain place gives rise to a kind of "chain reaction" changing the structure of production, relationships among industries, production links, the character of consumption, the direction of capital investment, urban and transport construction and many other aspects of the economic life of the "atom," that is the local territorial-production complex, in most cases an industrial node.

The local complex is part of a larger form, the regional territorial production complex, which can be regarded as a "molecule." A large plant, by affecting the life of the "atom," also exerts a certain influence on the "molecule."

The regional territorial production complex is the principal element within the territorial division of labor within the country. The operations of a large industrial plant are directly or indirectly reflected to a greater or lesser extent in the system of inter-regional, and in some cases even international, ties.

How are we to calculate from the economic point of view the site of a planned enterprise within territorial production complexes of various scales and within the system of the territorial division of labor within the country? This requires the construction of models of territorial production complexes (regional and local) and an analysis of the variants of the location of large industrial plants within these complexes. Each of the models of variants of changes within the complexes must then be "included" in the system of inter-regional ties and examined from the point of view of the effectiveness of the new project (or change in specialization) of the plant.

The construction of models must be based on the theory of territorial production complexes. In this connection let us recall N. N. Kolosovskiy's definition: "A production complex is an economically mutually conditioned combination of enterprises, situated in a certain industrial node or in a whole region, that achieves a certain economic effect because of a suitable, planned choice of enterprises 'n accordance with the natural and economic conditions of the region, its transportation facilities and its economic-geographic location" (N. N. Kolosovskiy, "The territorial production combination (complex) in Soviet economic geography," Voprosy geografii, No. 6, 1947, p. 137). Further on we read: "The concept of territorial production groupings and combinations (complexes) can be used equally well

for the study of the process of formation of both the large economic regions of the order of the Gosplan regions and the smaller taxonomic units of internal regionalization, down to an analysis of specific production groupings around a small urban settlement. The difference will be only in the degree of generalization of the production processes that make up the substance of the economy of the given combination (complex), i.e., in adapting the method to the scale of the problem" (same, p. 139).

A theory of complexes using the method of the economic computation of models of these complexes has been formulated in the United States recently. Here is how Walter Isard defines a complex: "An industrial complex may be defined as a set of activities occurring at a given location and belonging to a group (subsystem) of activities which are subject to important production, marketing, or other interrelations. (In the extreme, the set of activities may reduce to a single activity, which for convenience of exposition is still defined as a complex.)" (Walter Isard, Methods of Regional Analysis: An Introduction to Regional Science, New York - London, 1960, p. 377). Then Isard cites the example of an industrial complex in which the mining of coal and iron ore is combined with the production of pig iron and steel and, finally, with steel fabrication and a market for steel products. "Hence, to repeat," Isard concludes, an adequate regional analysis must consider the whole combination of activities in their various interrelations". (same, p. 377).

A comparison of the definitions by Kolosovskiy and Isard clearly shows that differences in the social-economic systems of the USSR and the United States have led to a different understanding of complexes. For Kolosovskiy a complex is a regular mutually conditioned combination of enterprises (Isard's combination of activities), moreover not an accidental, but a planned, rational combination, yielding a certain economic effect for the nation's economy. In view of the haphazard character of capitalist production, Isard cannot pose the question of a planned combination of producers or of the effectiveness of the combination for the economy of the whole country. Unlike Kolosovskiy's, Isard's definition does not reflect the principle of maximum labor productivity. Isard analyzes industrial complexes not from the national economic point of view but in the interests of private capital with a view to determining the advantage of investing the entrepreneur's capital in an existing (or planned) element of these complexes. Under certain conditions the interaction of the entire complex can provide an additional net profit to the entrepreneur to locate his enterprise within it.

Despite the differences in principle between the definitions of Kolosovskiy and Isard, the technique of studying complexes and constructing models that has been proposed by Isard deserves our attention.

Isard begins by constructing a technological scheme of the links between various types of production that are theoretically possible in a given place. In the example he cites for Puerto Rico, the complex is based on an oil-refining industry; he uncovers complex "clusters" of interrelated types of production that are technically feasible on that base. But all these production

types are not necessarily economical, and that means economical from the point of view of the entrepreneur, not that of the country. Isard says that the choice of enterprises from among the technological "clusters" is related to the availability of cheap labor in Puerto Rico, and that priority should be given to the location of labor-oriented chemical industries. The production of artificial fertilizer for the internal market would also be economical, and so forth. With due consideration for local economic conditions, according to Isard, a specific industrial complex consisting of several interrelated enterprises is then selected from among the innumerable technologically related and technically feasible types of production.

An economical selection from among several technically feasible enterprises that are specific for a given industrial complex is also needed under Soviet conditions, with the essential difference, first, that the complex be created in the interests of the economy of the country as a whole; second, that it combine usually enterprises of diversified industries (Isard gives as examples single-industry complexes, reflecting the fact that capitalist construction is organized predominantly by industrial branches), and, third, that the criteria for the economical selection of enterprises of an industrial complex differ -- they are no longer maximum profits but national economic effectiveness aimed at satisfying the constantly growing needs of the people.

Following a now common practice in American economic studies, Isard then builds a matrix showing inputs and outputs according to consumer and producer goods (the balance of the complex). Both the vertical columns and the horizontal rows represent basic types of raw materials, fuels, semi-finished goods, parts and finished products that enter into the production process of the industrial complex and form its structure. The squares formed by the intersection of lines separating the basic types of raw materials, fuels, etc., contain numerical indices (in weight units) with minus or plus signs. The minus signifies consumption within the complex and the plus export out of the complex. The table clearly shows how a production complex is made up, what raw materials and semi-finished goods are processed entirely within the complex into finished products or, if the complex is not integrated, what semi-finished goods are exported. This matrix constitutes an approach to construction of the model of the complex, showing the basic quantitative relationships between raw materials, fuels, all major semi-finished goods of intermediate production stages, the finished products and the by-products of the enterprises of the industrial complex.

The following stage of Isard's analysis of a complex consists of comparing the cost elements of the finished products of its enterprises to determine net profits under various alternatives.

The industrial complex consists not only of several interrelated factories and plants. It also includes transportation, urban centers with their population, services (municipal services, service industries, hospitals, schools) and so forth. Isard and other researchers in the United States determine the necessary proportions of all elements of the complex, their relationships,

links, consumption needs, production results, net profits and outlays. This yields an even more complicated model of the industrial complex.

As Isard reported at the 19th International Geographical Congress in Stockholm, he then proceeds with a kind of economic-geographic experiment. He places a large plant, say, a steel mill, within the matrix of the complex (or region) and then analyzes all the changes produced by the introduction of the new plant, including expansion of consumer goods production designed to satisfy the demand of the growing population, growth of investments in steel-consuming enterprises and related industries, and so forth. The experimenter can try to fit the new plant into various complexes, comparing alternatives and finding the optimal variant.

The technique of analyzing not only industrial but also broader territorial production complexes, including agriculture and other segments of the economy, by means of models deserves serious attention.

In the USSR, as early as 1933, the Angara Bureau in planning industrial enterprises regarded them as elements of a large territorial production complex and used complicated economic calculations to determine the maximum productivity of the enterprises of the complex. However that method did not win wide acceptance. In the planning of large industrial projects, it is now the practice to compare various technical and economic alternatives of such projects outside the framework of the models of given areas of territorial production complexes or industrial nodes. The tasks that planning organizations now face in locating large new plants in sites that are optimal from a national economic point of view would seem to make the construction of and experimentation with models quite essential.

The construction of models involves several kinds of studies. First a scheme of the production links of the territorial complex must be drawn up, showing existing and planned links between segments of the economy. Such schemes (they appear in the works of N. N. Baranskiy, A. I. Preobrazhenskiy, P. N. Stepanov, Yu. G. Saushkin, T. A. Solovtsova and others) clearly show the production links between various economic segments. However schemes of production links give no picture of the quantitative indices, which are best uncovered by means of the matrices proposed by Isard and by other balance calculations.

The schemes and tables (matrices), together with economic maps providing a spatial representation of the complex, make up what we may call a complete model of the complex.

Once we have models of several complexes, we can compare similar complexes with one another to arrive at an optimal solution of their production specialization.

There are, for example, several alternatives for the location of a large steel plant based on the iron ores of the Kursk Magnetic Anomaly. These

alternatives must be compared not only as separate projects, but as parts of the models of the territorial production complexes of the Central Chernozem, Volga-Vyatka and Southern Mining-and-Industrial regions and the corresponding industrial nodes.

The large industrial nodes on the Volga River, such as Kuybyshev, Saratov and Stalingrad, have much in common in their economic-geographic location and industrial structure in addition to some differences. In future each of these nodes should specialize rather than duplicate the others, i.e., a clear territorial division of labor should be provided among them. This also requires the construction of models of each node and careful fitting (with comparison of indices) of existing and especially of new enterprises to these models.

Regional and local economic models should be created for the rational location and proper specialization of all large enterprises.

If we are to create a perfect model of a regional complex or a local node, its boundaries must be scientifically justified. Arbitrary or artificial boundaries cannot be used for that purpose. Moreover, an objectively existing region, complex, or node should be used for the model.

We find that a subjectivism in the definition of regions, as reflected in the book American Geography: Inventory and Prospects, is rather widespread in capitalist countries. After having delivered his paper at the Geographical Congress in Stockholm, Isard was asked: Does not the construction of regional models point to the need of delimiting regions with definite boundaries and to the objective existence of regions? Isard replied in the affirmative.

Since the start of the Nineteen Twenties most Soviet economic geographers have been studying regions as objectively existing phenomena and, by delimiting scientifically justified and objectively existing regional complexes, they have contributed much to the proper location and improved specialization of industrial enterprises in the Soviet Union. One of the immediate tasks now is to create methods for building models of territorial production complexes and experimenting with them, as well as to master the technique of calculating the site of an enterprise in complexes with a view to insuring the maximum productivity of social labor.

NEWS NOTES

By Theodore Shabad

In recent months the Soviet press published reports on the fulfillment of the 1960 economic plan and on the plan for 1961. The reports contain the following data of interest to geographers.

Iron and steel. Iron and steel production increased by 9 per cent in 1960 and the same rate of growth is envisaged for 1961. A somewhat more rapid rate (11 per cent) for steel pipe is related to the current program of oil and gas pipeline construction. The principal production figures of the iron and steel industry appear in Table 1 (in million metric tons).

Table 1

	1959	1960	1961 Plan
Pig Iron	43.0	46.8	51.2
RSFSR	19.9	21.6	22.8
Ukraine	22.3	24.2	26.6
Crude steel	60.0	65.3	71.3
RSFSR	33.6	36.6	40.4
Ukraine	24.0	26.2	28.0
Rolled steel	47.0	50.9	55.3
RSFSR	25.7	27.9	30.4
Ukraine	19.6	21.1	22.8
Steel pipe	5.2	5.8	6.4
RSFSR	2.6	2.9	no data
Ukraine	2.0	2.2	no data
Coke	53.4	no data	no data
RSFSR	23.5	25.4	
Ukraine	29.2	30.1	
Iron ore	94.4	107	no data
RSFSR	36.5	40.4	
Ukraine	53.5	59.1	
Kazakhstan	3.2	5.8	7.1

In the RSFSR, a large blast furnace (at Stalinsk), six open-hearth furnaces, the "2500" sheet mill at Magnitogorsk and the "2800" plate mill at Novotroitsk were the principal projects completed in 1960. Plans for 1961 include the start of operations at three blast furnaces at Cherepovets, Tula and Lipetsk, ten open-hearth furnaces and eight rolling and pipe mills. The latter will include a continuous seamless-pipe mill at Pervoural'sk, and new pipe-making facilities at Taganrog and Novosibirsk. Operations are expected to start at new iron mines at Kachkanar (Sverdlovsk Oblast) and in Murmansk Oblast, as well as in the Kursk Magnetic Anomaly.

In the Ukraine, blast furnaces were completed in 1960 at Voroshilovsk and Krivoy Rog, a blast furnace was rebuilt and expanded at Yenakiyevo and four electric furnaces were added to the Dneprospetsstal' special steel plants at Zaporozh'ye. During 1961, as part of the construction of the Krivoy Rog steel plant, a second large blast furnace is expected to be completed. Other 1961 projects are six open-hearth furnaces at Krivoy Rog and Zhdanov, two coke batteries at Voroshilovsk, four electric furnaces at Almaznaya and pipe mills at Dnepropetrovsk and Novomoskovsk.

Fuels. Continued emphasis on oil and gas is evident from a 14 per cent increase in oil production and a 27 per cent rise in gas output while coal mining remains virtually stationary, except for coking coals. The principal fuel production figures (in million metric tons, except for gas, which is in billion cubic meters) appear in Table 2.

Table 2

	1959	1960	1961 Plan
Petroleum	130	148	164
RSFSR	103	119	134
Azerbaydzhan	17.1	17.8	18.7
Turkmenia	4.6	5.3	6.0
Natural Gas	37	47	63
RSFSR	19.8	25.8	33
Ukraine	9.5	14.3	21.5
Azerbaydzhan	4.8	5.8	6.5
Coal (all grades)	506.6	513	511.7
RSFSR	297	298	
Ukraine	168	172	
Kazakhstan	31.7	32.4	34.6
Coking coal	101	110	
RSFSR	35.7	37.8	
Ukraine	55.8	62	
Kazakhstan	7.1	8.3	

As a result of the priority development of oil and gas production the share of these two fuels has risen steadily in recent years in the total Soviet fuel production. The oil-gas share was 31.8 per cent in 1958, 34.5 per cent in 1959, 38.2 per cent in 1960 and is planned to reach 42 per cent in 1961. Coal has been assuming a correspondingly lesser role.

In the RSFSR, oil production is increasing at a rapid rate in the Volga-Urals fields, notably the Tatar ASSR, the Bashkir ASSR and Kuybyshev Oblast. Natural gas production comes mainly from the Northern Caucasus fields of Krasnodar and Stavropol', as well as from the older fields in the Saratov area. Coking coal production is to be expanded in 1961 mainly in the Kuznetsk Basin.

In the Ukraine the principal natural-gas field is Shebelinka, south of Khar'kov, followed by the older Dashava field, in the foothills of the Carpathian Mountains. Dashava is already linked by pipelines with Kiev-Moscow and with Minsk. In 1961 the Minsk line is to be extended to Vilna and Riga in the Baltic region. Shebelinka is already connected with the pipelines going from the Dashava and Northern Caucasus fields to Moscow, as well as with Dnepropetrovsk. In 1961 a second pipeline from Shebelinka to Dnepropetrovsk is to be completed and work is expected to begin on a line from Shebelinka to Kiev.

Electric power. Soviet electric power generation rose from 265 billion kilowatt-hours in 1959 to 292 billion in 1960; the 1961 goal is 327 billion kilowatt-hours. In the installation of generating capacity in 1961, priority will be given to thermal stations, whose capacity is expected to increase by 7.8 million kilowatts. About 45 per cent of the added thermal capacity will consist of generating units of the order of 100,000 to 200,000 kilowatts. Three million kilowatts of thermal capacity are to be added in the RSFSR and 1.4 million in the Ukraine. According to the 1961 plan, the RSFSR is also expected to add 1.5 million kilowatts of hydro-electric capacity, including the first generating units at the Bratsk station on the Angara River in Siberia, and at the Votkinsk station on the Kama River.

Agriculture. Although the Soviet Union exceeded the poor 1959 harvest in most crops, it did not reach its farm goals last year. Increases over the previous year were recorded in grains, sugar beets, sunflowers, flax and vegetables, but the cotton and potato crops fell below the 1959 levels. The total cropland in 1960 amounted to 203 million hectares, an increase of 6.7 million over 1959. The expansion was brought on largely by heavy losses of winter crop seedings during the severe winter 1959-60.

Among the three principal grain-producing republics, only the RSFSR exceeded the 1959 harvest while both the Ukraine and Kazakhstan fell below the 1959 levels (Table 3).

Table 3

Total Grain Production
(in million metric tons)

	1958	1959	1960
USSR	141.2	125.9	133.2
RSFSR	79.0	69.6	78.6
Ukraine	31.3	27.5	26.7
Kazakhstan	22.0	19.1	17-18

As a result of a 12 per cent increase in the sown area, mainly in the RSFSR, the sugar-beet crop of 1960 -- 56.9 million tons -- was a record, exceeding even the 1958 harvest of 54.4 million tons (Table 4).

Table 4

Sugar-Beet Production
(in million metric tons)

	1958	1959	1960
USSR	54.4	43.9	56.9
RSFSR	16.1	12.1	20.4
Ukraine	33.5	27.0	31.0

The Soviet cotton crop (unginned) was 4.4 million tons in 1960, compared with the 1959 record harvest of 4.7 million, because of a decrease in the crop of the Uzbek Republic, the principal producer (Table 5).

Table 5

Soviet Cotton Crop
(in million metric tons)

	1958	1959	1960
USSR	4.4	4.7	4.4
Uzbekistan	2.9	3.2	2.8
Tadzhikistan	.46	.47	.46
Turkmenia	.38	.36	.36
Azerbaydzhan	.27	.30	.37

Meat production was set back somewhat in 1960 despite the high priority attached to it under the current Soviet farm program. Total output (slaughter weight) was 8.7 million metric tons in 1960 compared with 8.9 million (revised figure) in 1959. Of the 1960 total, 4.4 million tons was processed in meat-packing plants and 4.3 million on collective farms and in private households. Of the total meat output, 5.3 million tons was supplied by collective and state farms and 3.4 million tons by private herds. The share of the private sector in meat production has declined. In 1959 it contributed 4 million tons and state and collective farms 4.9 million tons.

Milk production, also a priority item, declined slightly from 61.7 million tons in 1959 to 61.5 in 1960. Butter output -- 848,000 tons in 1960 -- remained virtually at the 1959 level (845,000). In 1960 creamery butter production amounted to 728,000 tons while 120,000 tons was produced on collective farms and in households. Wool production also remained virtually stationary, advancing from 355,500 tons in 1959 (revised figure) to 357,000 in 1960.

Livestock holdings increased in 1960, except for sheep, which were seriously affected by disease. Year-end livestock holdings (in million head)

changed as follows: cattle from 74.2 in 1959 to 75.8 in 1960, of which cows from 33.9 to 34.8; hogs from 53.4 to 58.6 and sheep from 136.1 to 132.9.

Transportation. Railroads continued to handle about 80 per cent of all freight traffic in 1960, accounting for 1,500 billion metric ton-kilometers. Conversion of the railroad system to Diesel and electric traction continued at a rapid rate. During 1960, lines served by Diesel and electric engines increased from 25,900 to 31,000 kilometers. These lines handled 43 per cent of the freight traffic compared with 33.5 per cent in 1959. Waterways accounted for 100 billion ton-kilometers in 1960 compared with 93.6 billion in 1960. Trucking accounted for nearly 100 billion ton-kilometers in 1960 compared with 87.6 billion in 1959. Of the total trucking traffic, 26 billion ton-kilometers was handled by consolidated public trucking fleets and more than 70 billion by fleets owned by industrial enterprises and collective farms. Rapid expansion continued in pipeline transportation. The main oil-pipeline network expanded from 16,700 to 18,700 kilometers during 1960, and its traffic increased from 41.6 billion ton-kilometers in 1959 to 51 billion in 1960.
(Sources: Pravda, December 21, 1960; January 26, 1961; Sovetskaya Rossiya, December 27, 1960; January 27, 1961; Pravda Ukrainy, December 28, 1960; February 7, 1961; Kazakhstanskaya Pravda, January 4, 1961; January 31, 1961.)

Sochi City Limits Expanded. The coastal sections of Adler and Lazarevskoye rayons have been incorporated into Sochi. The Sochi municipal area now extends 85 miles along the coast from the border of the Georgian SSR to Tuapse. Sochi city is divided into four urban rayons: Adler, Lazarevskoye, Khosta and Central. One of the principal southern resorts of the Soviet Union, Sochi was visited by 600,000 persons in 1960. Sochi was for ten years (1948-58) directly under the jurisdiction of the RSFSR Government, but has now again been returned to the jurisdiction of Krasnodar Kray. The 1959 population of Sochi was 95,000. (Sovetskaya Rossiya, February 12, 1961.)

Middle Siberian Railroad. With the completion of the Omsk-Karasuk railroad (see Soviet Geography, February 1961, p. 76), further details have been published on the state of progress of the Middle Siberian Railroad project. To be completed by 1965, it will connect Barnaul with Aydyrlya station (halfway between Kartaly and Orsk) with a 2,100-km. trunk line passing through the virgin lands of northern Kazakhstan. Construction of the Middle Siberian system began in 1955 in connection with the start of development of the virgin lands. At first a system of narrow-gauge lines was envisaged; later the plan was changed to a broad-gauge system to be connected with the Soviet rail network. In addition to the Omsk-Irtyshskoye-Karasuk line, broad-gauge lines now in operation are: Kamen'-na-Obi--Karasuk, Kzyl-Tu--Kokchetav, Peski-Uritskoye and Kustanay-Tobol-Dzhetygara. Narrow-gauge lines completed in 1955 and now to be converted to broad gauge are: Uritskoye-Kustanay and Kokchetav-

Volodarskoye. Yet to be built are the following sections: Barnaul-Kamen', Irtyshskoye--Kzyl-Tu, Volodarskoye-Peski and Dzhetygara-Aydyrlya. While grain movements and supplies for the virgin lands make up most of the freight on the central and eastern sections of the Middle Siberian system, industrial raw materials predominate on its western sections. The main freight there is the iron-ore concentrate moving from the Sokolovka-Sarbay mines at Rudnyy (on the Kustanay-Tobol rail section) to the steel mills of the Urals, notably Magnitogorsk and Chelyabinsk. The Tobol-Dzhetygara section provides transportation for the large asbestos-mining project under construction at Dzhetygara (Kazakhstanskaya Pravda, February 9,1961).

Pavlodar Power Plant Opens. The Pavlodar steam-power station Tets No. 2 began to generate power in February 1961. Start of operations at the station , which is fueled with coal from near-by Ekibastuz, will help speed construction of the Yermak GRES thermal power project and of the Yermak ferroalloys plant. Yermak is 20 miles southwest of and across the Irtysh from Pavlodar. Other industrial projects at Pavlodar under the seven-year plan are aluminum, combine harvesters and oil refining (Pravda, February 2, 1961).

Caspian Shipping Agencies Consolidated. Shipping in the Caspian Sea in the past has been under two agencies: the Caspian Shipping Agency proper and the Caspian Roads Shipping Agency, which handled navigation in the shallow northern reaches of the Caspian Sea, including transshipments of oil cargoes at the Astrakhan' 12-foot roadstead from deep-draft Caspian tankers to shallow-draft roads tankers. With the increasing introduction of shallow-draft tankers in Caspian Sea service (Soviet Geography, June 1960, p. 75, and January 1961, p. 77), the costly transshipments at the 12-foot roads have been virtually eliminated. The Soviet Ministry of the Merchant Marine has now abolished the Caspian Roads Shipping Agency and consolidated it with the Caspian agency proper. Shipping lines formerly under the roads agency (Astrakhan'-Bautino-Gur'yev) will now be handled by the Astrakhan' division of the Caspian Shipping Agency. Direct shipments of oil, lumber, cotton, salt and other goods between ports of the Caspian Sea and the Volga River are expected to increase as more shallow-draft freighters join the Caspian fleet (Bakinskiy Rabochiy, February 1,1961).

Mikun'-Syktyvkar Railroad Opens. This line, opened in December 1960, provides the first rail link between Syktyvkar, capital of the Komi ASSR, and Mikun' on the main Pechora railroad. Mikun' is developing into a major rail center of northern European Russia. In addition to the spur to Syktyvkar, a lumber railroad is under construction from Mikun' to Koslan, center of rich timber reserves of the upper Mezen' River (Bakinskiy Rabochiy, February 1, 1961).

New Atomic Research Center. A new town built around the Nuclear Physics Institute of the Uzbek Academy of Sciences has been named Ulugbek, for a 15th-century astronomer. Ulugbek is situated about 20 kilometers northeast of Tashkent, near Kibray (Pravda Vostoka, February 5, 1961).

New Natural Gas Lines. A branch of the Dashava-Moscow line has been completed to Gomel' (Belorussian SSR). The branch leaves the main pipeline at Shchors, between Kiev and Bryansk. It will supply gas to the Kostyukovka glass factory near Gomel', one of the largest window-glass producers of the USSR. Gomel' is the second Belorussian industrial center served by Dashava natural gas, Minsk having been reached in 1960 (Pravda, January 30, 1961).

A gas line has been completed from the gas field at Kanchura near Kumertau to Ishimbay in the Bashkir ASSR (see Soviet Geography, September 1960, p. 82). At Ishimbay the new line joins the Shkapovo-Ishimbay-Magnitogorsk gas pipeline to supply gas to the open-hearth furnaces of Magnitogorsk. The Shkapovo-Magnitogorsk line, built in 1957-58, carries natural gas from the Shkapovo oil field. The Shkapovo field gas is also piped to a carbon-black plant at Oktyabr'skiy in the western part of Bashkiria. This autonomous republic, though long a major oil producer, has only recently begun to make use of its gas resources (Ekonomicheskaya Gazeta, January 26, 1961; Sovetskaya Rossiya, February 2, 1961).

New Hydroelectric Projects. Work has started on the Plyavinyas hydroelectric station on the Daugava River in Latvia. The 600,000-kw. station is under construction below the town of Plyavinyas, near the railroad station of Ayzkraukle, from which a spur is being built to the construction site. The station is to be completed in 1963. A large reservoir behind the new station will regulate the flow of the Daugava River, whose seasonal low winter stage has prevented the smaller Kegums hydroelectric station, downstream from the Plyavinyas site, from working at full capacity. Since 1953, when the fourth and last turbine was installed in the Kegums station, Latvian hydroelectric power output has fluctuated between 331 million kilowatt-hours (1959) and 510 million (1957). The Plyavinyas reservoir, in addition to adding the installed capacity of its own station, is expected to assure more uniform power generation at Kegums (Izvestiya, February 2, 1961; Sovetskaya Latviya, October 25, 1959 and May 25, 1958).

Work has also started on the Nurek hydroelectric station on the Vakhsh River in the Tadzhik SSR, eastsoutheast of Stalinabad. The station will have a capacity of 2,790,000 kilowatts, in the form of nine turbines of 310,000 kw. each. The dam, one kilometer long and 300 meters high, is envisaged to be one of the highest in the world. First power production is planned for 1964 (Ekonomicheskaya Gazeta, February 7, 1961; Sovetskaya Rossiya, March 10, 1960.) Among the industrial projects that may be powdered by the Nurek station is an aluminum project based on Angren kaolin (see Soviet Geography, May 1960, p. 89).

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